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MAINTENANCE ENGINEERING

In Plants, Mills, and Factories

EVERY manufacturer today finds himself confined between two solid barriers over which he can exercise no direct control. Before him he sees the price his goods will bring, dictated by laws of supply and demand. Behind, the cost of materials and labor hems him in, for labor and material prices automatically adjust themselves to forces whose action he, as an individual, can vary hardly at all.

How, then, shall he increase his freedom and comfort within this tight inclosure? How shall he raise his own profits, strengthen his competitive ability?

He can secure a more economical combination of factors of production. With everything else almost rigid, he finds that there is one elastic medium upon which he can operate. It is that part of his costs as dictated by his choice and application of equipment. Let him focus his attention upon this one area where his endeavors bring the highest and quickest returns.

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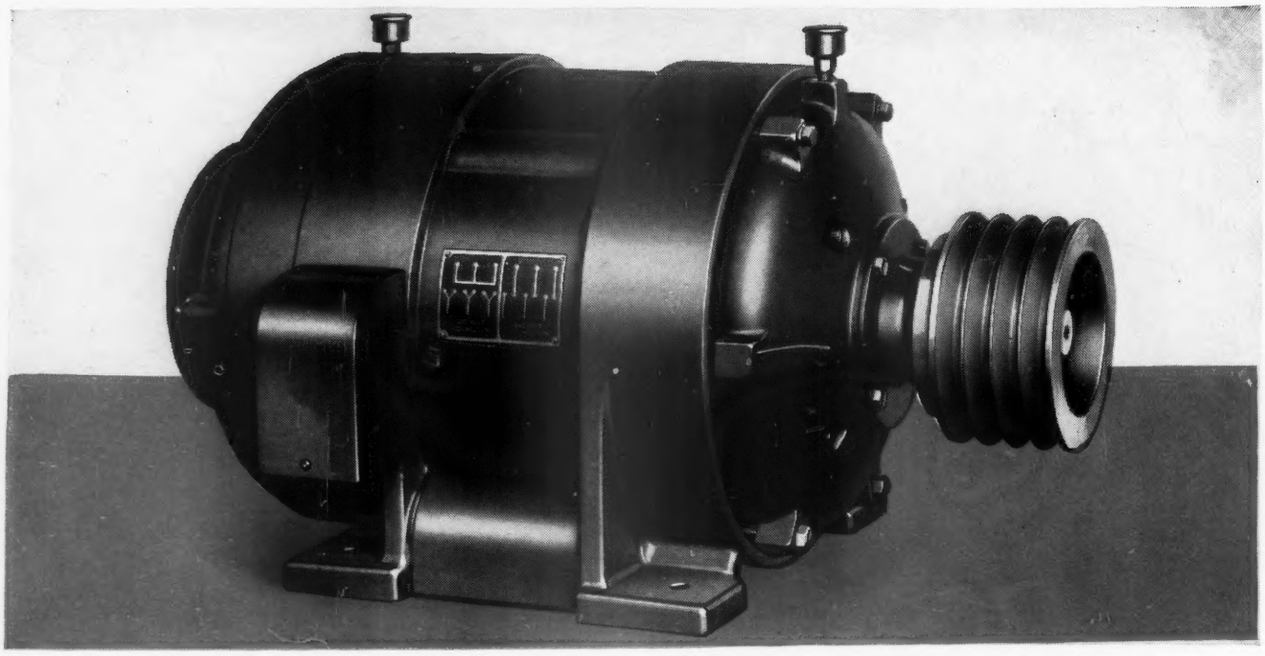

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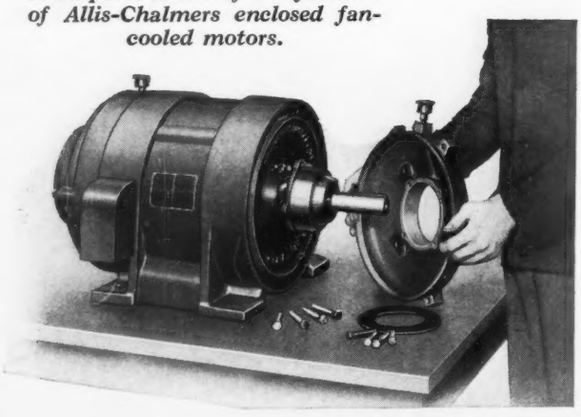

Allis-Chalmers Mfg. Co., Milwaukee

ALLIS-CHALMERS MOTORS

MAINTENANCE ENGINEERING

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JANUARY
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Planned Counter-Offensives Against Fire

E. B. ADAMS

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Western Electric Company
Baltimore, Md.

F. W. BUCK

Chief Mechanical Engineer
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THE FOUR requisites of adequate fire protection are incorporated in the system at the Point Breeze plant of the Western Electric Company, Baltimore, Md. These essential features are first, complete protection—every square foot of space is taken care of; second, accessibility and adequate control; third, entire independence of any domestic water service; and fourth, absolute reliability at all times, under all conditions.

In addition to the protection afforded by the yard hydrant system, the three main manufacturing buildings are equipped with sprinkler systems. The boiler house and switch room are not sprinklered, because the boiler house contains little combustible material except coal, and the danger and damage done by water in the switch room would be greater than that by fire. The oil house is protected by a steam fire smothering system. The two well houses stand alone; as there is no combustible material in them, no fire hazard exists, and consequently these buildings are not sprinklered.

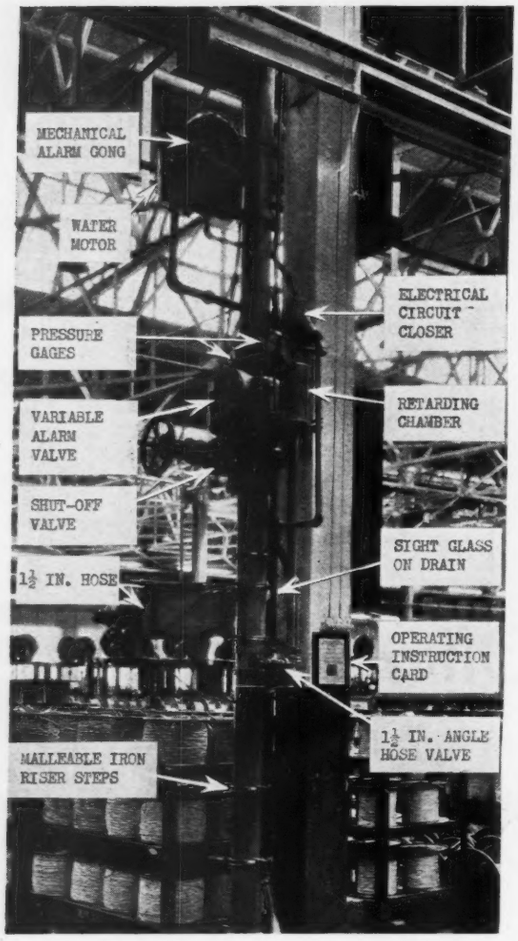
Water Supply and Distribution—For dependability, a water main providing the supply is a part of a loop system, so that in case of failure at one end an ample supply may be provided from the other. At present the water supply is drawn from the city of Baltimore's 20-in. main on one side of the property, and a 12-in. city water line on the other side, supplied from a different section of the city.

The plant stands at the confluence of Colgate Creek and the Patapsco River. Later the 20-in. main will be extended to connect with other mains serving the area east of the Creek and in this way provide an even more reliable and adequate supply of water.

It is desirable for a large plant to have a second water supply entirely independent of the city water, usually taken from elevated tanks. The Point Breeze building program includes a group of six-story buildings which will carry storage tanks with a total capacity of 100,000 gallons.

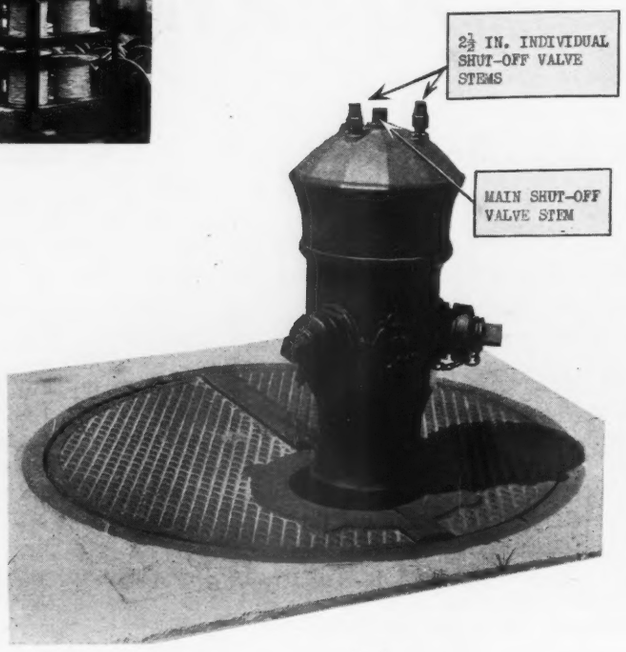
To supply adequate pressures, two fire pumps were installed, with provisions for a third. The pumps conform to the specifications of the National Board of Fire Underwriters and each is equipped with six 2½-in. hose test valves. They are of the one-stage centrifugal type, are steam turbine driven at a speed of 2,200 r.p.m., and have a capacity of 1,500 gal. per min. each, at 125 lb. pressure per sq.in. The suction side of the fire pumps is connected to the 16-in. city water supply. The pumps discharge directly into the fire protection system. Although the city water pressure averages about 75 lb. per sq.in., it is not relied upon in the event of a fire; one fire pumps is started immediately.

Underground piping was laid as a



Typical sprinkler riser.

All hydrants are installed over concrete pits or manholes, to permit ready access to the hydrants without disturbing sidewalks or lawns.



loop system and provided with concrete sectionalizing valve pits located at each intersection and at points where branches are taken off to serve the various buildings in the plant.

As future construction work is finished, underground loops will be completed to serve the new units and will be supplied with sectionalizing valves. Provisions also have been made to accommodate future extensions to the present buildings, several of which will be enlarged.

Yard fire hydrants are taken off the underground distribution system and spaced approximately 250 ft. apart around each building and at other strategic points throughout the plant. Wherever possible the hydrants are located along roadways, where they are easily accessible to fire trucks. Instead of installing hydrants near the curb, as is the usual practice, they are placed beyond the sidewalks. Thus they do not interfere with pedestrian traffic and are not likely to be damaged by large trucks.

Each hydrant is provided with a 6-in. flanged inlet and two 2½-in. hose outlets, fitted with an internal type valve, operated by a special, pentagonal shaped nut at the end of a bronze stem projecting through the top of the hydrant. A steel stem with a bronze extension on the main shut-off valve has a similarly designed nut, but of larger size. All hydrants are installed over concrete pits or manholes, which are covered with a 36-in. diameter, split, cast iron cover that fits eccentrically around the hydrant. The pits permit ready access to the hydrants for repairing or replacing parts without disturbing the sidewalks or lawns.

Sprinkler System—For the automatic sprinkler system 4-in. and 6-in. risers are used, accommodating 80 and 200 sprinkler heads respectively. In most cases an 8-in. branch from the main serves two 6-in. risers. The cable building contains 5,420 automatic sprinkler heads fed by 26 6-in. risers. In the insulated wire building there are 4,268 heads fed by 21 6-in. risers. The reel shop has 104 heads on one 6-in. riser.

Each riser is equipped with one length of 1½-in. linen fire hose, riser steps, variable-pressure alarm valves, shut-off valve, drain valve, mechanical alarm gong, water motor, two pressure gages, one connected below and the other above the alarm valve, and a circuit closer and electrical connection which are wired to the sprinkler leakage alarm annunciator in the alarm room of the power house.

The riser steps are made of malleable iron and are spaced 15 in. apart, starting from the floor and reaching to a point within 2 ft. 6 in. of the shut-off valve. The 1½-in. hose is of unlined linen and is supplied in 50-ft. or 75-ft. lengths. At the top of each riser there is a connection for testing the alarm valve.

Paralleling each riser is a 2-in. drain line that serves the water motor and allows the system to be drained when repairs or changes are required. This drain is equipped with a sight glass near the ground floor, by means of which leaks may be detected.

The spacing and location of sprinkler heads are governed by National Board of Fire Underwriters rules, which take into account the type of building, construction, and the dimensions of the ceiling beams and bays. In general, one sprinkler head is required for every 90 sq.ft. of floor area.

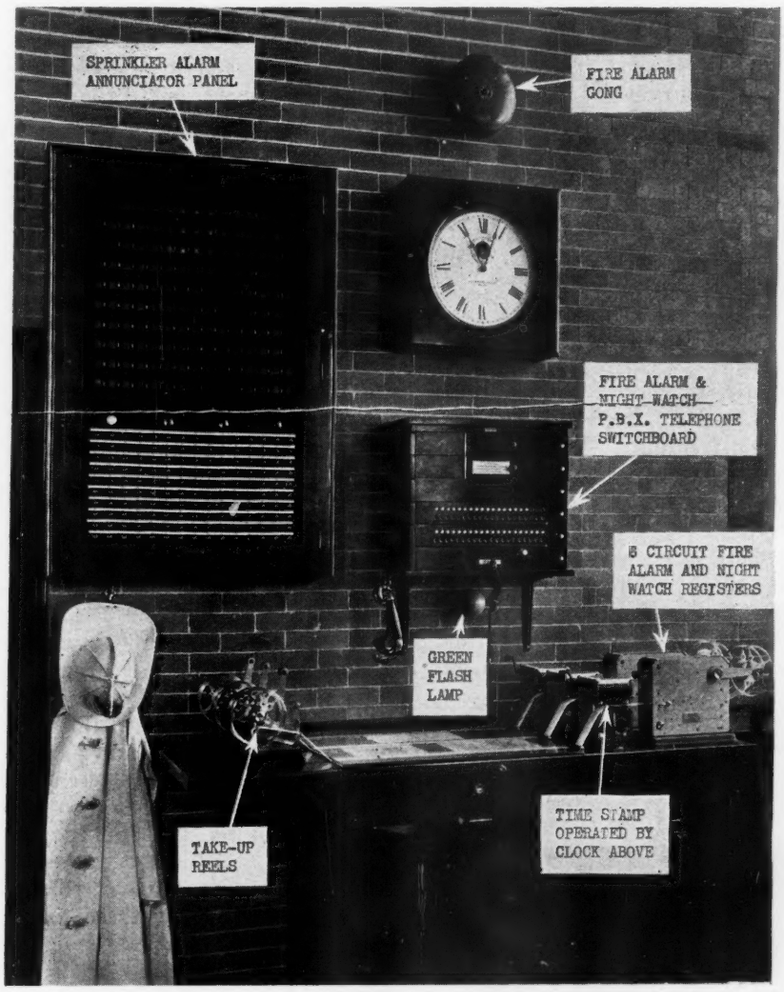
All sprinkler piping above the ground was tested to not less than 150 lb. per sq.in., hydrostatic pressure; the underground and hydrant lines were tested at a pressure of not less than 200 lb. per sq.in. The duration of the tests was two hours, and it was required that the piping should not show any indication of leaks, and that the pressure drop no more than 10 lb. in the first hour or 15 lb. in the two hours.

Accessory Equipment and Personnel—Hose houses to accommodate 2½-in., Underwriters-approved, rubber lined, cotton jacketed fire hose are installed where required, and are equipped with extra spanner wrenches, extra play nozzles, and sufficient lengths of hose.

There is also a fire alarm and night watch system. Special attention was given to the location of the pull boxes in order that all parts of the buildings and grounds might be adequately patrolled. Every precaution is taken, even to the extent of selecting and placing furniture, waste paper baskets, waste, rags, paper containers, storage of combustible materials, and so on.

A fire truck equipped with 1,000 ft. of 2½-in. rubber lined fire hose, hose stakes, all service gas masks, fire blankets, salvage covers, portable fire extinguishers, door openers, miscellaneous small tools, and the like, is located in the fire engine room and can reach any place in the Works in a few seconds after an alarm is sounded. There are three 8-hr. shifts of well trained firemen, with headquarters in the fire truck room. There are two other auxiliary squads made up of factory employees. The first responds at the first alarm given and goes to the fire station to substitute for the regular firemen. If another alarm is sounded, a second group responds in the same manner, always leaving a group at the fire station for emergency.

Like the regulars, the auxiliaries also are given training in the methods of fighting fire. In addition to these firemen, departmental fire crews are organized in each building. These men are trained in handling the portable fire equipment and the 1½-in. hose, and in the operation of sprinkler valves. Instructions are given to these men once a month, and fire drills are given periodically in order that the Works fire chief may check the efficiency of their operations. It also is the duty of the night watch patrolmen to investigate all valves on the fire protection system, close windows, and turn off all unused electric circuits. Specific duties are assigned to each round, such as inspecting valves and valve seals, fire pails, waste containers, and the like.


SPRINKLER ALARM ANNUNCIATOR PANEL
FIRE ALARM GONG
FIRE ALARM & NIGHT WATCH P.B.X. TELEPHONE SWITCHBOARD
8 CIRCUIT FIRE ALARM AND NIGHT WATCH REGISTERS
GREEN FLASH LAMP
TIME STAMP OPERATED BY CLOCK ABOVE
TAKE-UP REELS

The nerve center of the system. The works fire chief, with his maps and these signaling devices before him, is immediately informed of fire trouble in any part of the plant.

A section of the power house has been assigned as the central station of the fire department. Here are located the fire chief, firemen, fire truck, and complete equipment.

The works fire chief has maps before him giving the location of every sprinkler, riser, and hydrant throughout the works. Directly above his desk is located the sprinkler alarm annunciator panel. Normally a green light shows on the panel board, but when any flow of water goes through a sprinkler riser because of the opening of a sprinkler head, the green light goes out and the red light shows. There is also a bell inside the panel cabinet, and an indicator on the outside, the latter showing the number of the riser in which water is flowing. In order to stop the bell this indicator may be closed. When this is done the red light goes out, and a white light shows and will continue to burn as long as water is flowing.

Beneath the annunciator panel is a table containing registers recording the number of box by code perforation and the exact time each watchman rings in on his round by a time and date stamp. If a watchman is reporting at the box the signal will be given once, but a fire alarm from the box will repeat the signal seven times. Also, when a fire alarm comes in a single acting gong rings out, and a green light flashes the number of the box. These signals are in parallel and either can be used in case of failure of the other.

Each combination fire alarm and watchman's signal box is equipped with a telephone jack into which the watchman may plug his portable telephone set and so talk with the office. A buzzer located on each box permits the chief to call the watchman at any point on his round. The convenient telephone switchboard enables the chief, therefore, to get in touch with any watchman at any box. There is also a city fire alarm box centrally located so that in case of necessity the city fire department may be called. A pushbutton in the

fire house also permits sounding a fire signal on the steam whistle on the roof of the power house, as well as on auxiliary air whistles in each building. By this means the auxiliary fire squads are called to their proper positions.

All materials conform in all respects to the requirements of the National Board of Fire Underwriters. Valves 2½-in. and over are flanged, those under 2½-in. are screwed. Except for connection with valves, all fittings from the floor to the sprinkler heads inclusive are screwed. Those 2½-in. and over are cast iron long-turn; 2 in. and under, standard cast iron. All underground piping and fittings are of the bell and spigot type and all joints at change of direction are strapped.

The portable fire protection equipment consists of two kinds of fire pails. The first kind comprises water pails for ordinary use; the second, sand pails (containing a mixture of 80 per cent bicarbonate of soda and 20 per cent fine dry sand) for use in locations where paints and oils are used in quantities, as in varnish rooms and paint rooms, garages, and in places where highly inflammable liquids are employed. The pails are hung in conspicuous places, such as on columns along aisles, beside exit doors, and near drinking fountains. Water pails are painted red on the outside and lettered FIRE in black letters at least 2½ in. high. Sand pails are painted blue and are similarly lettered. The sand pails are sealed with paper covers to keep the contents free from moisture. One water pail usually is provided for every 2,500 sq.ft. of floor space. In some cases 2½-gal. chemical fire extinguishers have been substituted for water pails.

Fire Extinguishers—Four types of fire extinguishers are used at Point Breeze, namely, the soda and acid type; carbon tetrachloride type; foam type; and CO_2 type. The soda and acid type has a liquid capacity of about 2½ gal. The chemicals used are bicarbonate of soda and sulphuric acid. These extinguishers are effective for incipient fires on which water or solutions containing a large percentage of water are effective. They will throw a stream a distance of about 40 ft. To combat fires in live electrical equipment two types of fire extinguishers are used. The first type employs carbon tetrachloride, which is non-conductive and practically non-freezing. The principal action of this agent is to smother the fire by the heavy vapor given off when the liquid comes in contact with a flame or heated surface. Users of this type of extinguisher are cautioned not to inhale the toxic vapors, particularly in small inclosures that are not ventilated. CO_2 (carbon dioxide) type extinguishers also are used to extinguish fires in electrical equipment. This material is a non-conductor of electricity, and does not injure fabrics, nor is it injurious to the operators, except that it may become suffocating in a small inclosed space where a large volume is discharged.

The foam type of extinguisher is effective in extinguishing buring oils and all inflammable liquids, except alcohol and carbon disulphide in open containers. The foam floats on top of the burning liquid and smothers the fire. The chemicals consist of bicarbonate of soda, a foam-producing agent dissolved in water in an outer compartment, and aluminum sulphate dissolved in water in the inner cylinder.

Inspection and Maintenance—The portable equipment is examined periodically and recharged when necessary. The sprinkler water flow alarm system is tested frequently, and sprinkler heads are inspected for corrosive action. Sufficient extra heads of all temperatures are kept on hand for replacement purposes. Strict precaution is taken to prevent any part of the fire protection system from being blocked by trucks or stock even for a temporary period. It is essential that hose equipment be kept perfectly dry. Leaky valves at hose connections will rot the hose.

During construction the inspector was provided with a set of 1½-in. and 2½-in. plug and screw gages made in accordance with National Board of Fire Underwriters specifications. Each of the sizes of both the plug and screw gages consists of a "no go" plain gage and the "go" and "no go" screw gages. All hose couplings, nipples, play pipes, and hydrants must pass the test of these gages. The inspector also checked for interferences between sprinkler heads and other building construction and saw that the piping system was completely cleared and passed a satisfactory hydrostatic test. It is not permitted to add to or suspend anything from any part of the fire protection system except devices directly involved in the proper operation of the equipment. Where sprinkler heads are located under decks, stairs, or in other positions where they are likely to be damaged, they are protected by approved guards. Because as few joints as possible are desired, all piping is installed in full length, and short lengths are not allowed where a full or single piece can be used. Pipe hangers are installed on centers not exceeding ten feet.

The fire pumps, hydrants, and

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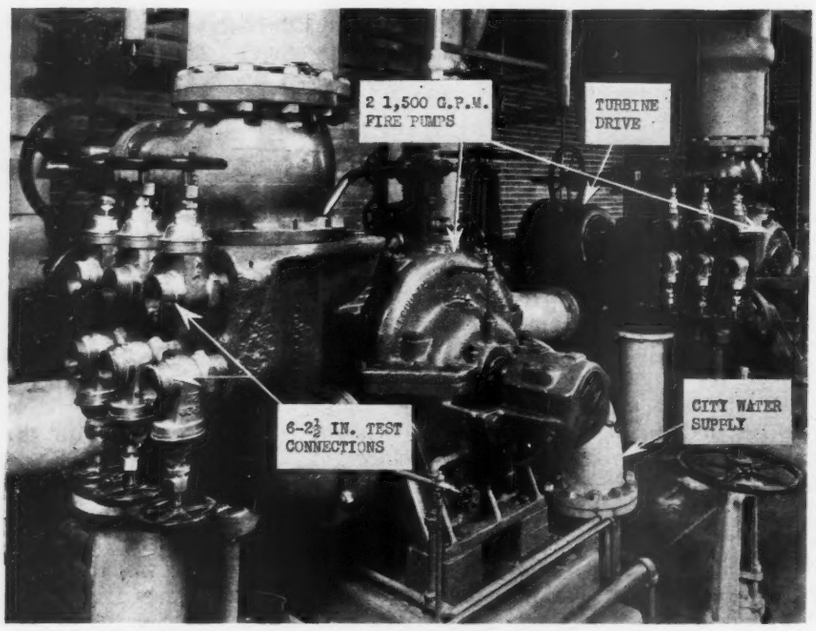
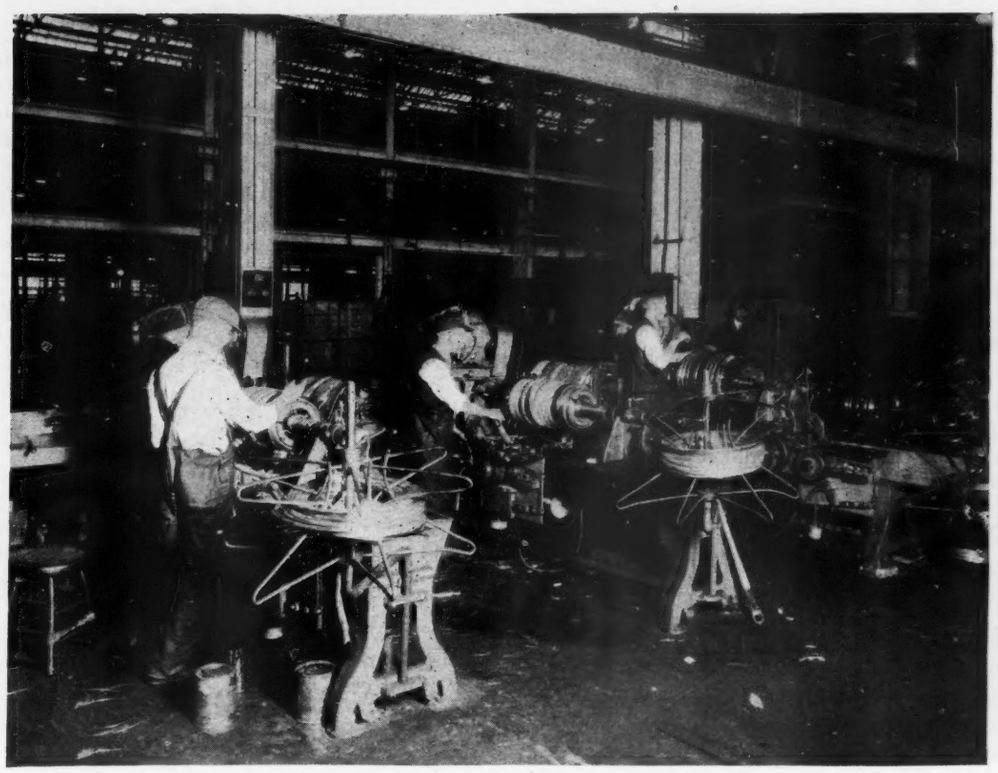


Fire pumps. One-stage, centrifugal type, steam-turbine driven, 2,200 r.p.m., with 1,500-gal. per min. capacity. In the event of fire one pump is started immediately.



Lathes equipped with automatic tension devices are used in applying temporary bands to armatures.

Temporary Banding of Hot Rotors

A. C. ROE

Renewal Parts Engineering Department
Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

TEMPORARY bands should be used when it is desired to obtain a solid, compact winding, as mentioned in the preceding article in the November issue. However, cold temporary bands do not permit pulling the winding together so solidly as is possible when the armature is preheated and temporary bands are applied to it while it is hot. The reason is obvious when we consider that the majority of windings today are wound with coils that are completely insulated and that have been given two or more dips in varnish and baked dry. The insulation on the coils and that used during winding is stiff and hard when cold. However, when subjected to heat the varnish and insulation tend to become softer, permitting the temporary bands to pull the winding together into a more compact unit.

Hot temporary banding may be done in two ways. In one method the armatures are dipped in varnish and baked; in the second, the armatures are not dipped and baked, but are finished with one or more coats of an air drying varnish. For the best results, dipping and baking are recommended with hot temporary banding. The combination of hot banding with dipping, Method A, will be discussed first.

Method A can be divided into six operations: (1) Preheating. (2) Dipping. (3) Preliminary baking. (4) Temporary banding. (5) Complete baking. (6) Final cold banding. Each operation will be covered in the sequence that should be followed in doing the work.

Preheating—The armature should be heated in an oven maintained at a temperature of 105 to 115 deg. C. (221 to 239 deg. F.) until it attains a temperature of at least 75 deg. C. (167 deg. F.). The time required to heat the armature to this temperature will vary with the size, but in general armatures up to 30 in. in diameter will require six to eight hours; for those more than 30 in. in diameter ten hours or more baking will be necessary.

Dipping—While the armature is hot immerse it in a good grade of black

baking varnish and allow it to remain under varnish at least five minutes; then drain and clean the varnish from metal parts, such as core and shaft. Keep the commutator out of the varnish.

Preliminary Baking — After the varnish has ceased dripping, return the armature to the oven and bake from four to six hours at a temperature of 115 to 125 deg. C. (239 to 257 deg. F.).

Temporary Banding—Remove the armature from the oven and as soon as it can be handled mount it in a lathe similar to those shown in the illustration, and start applying the temporary bands. The armature should be worked on as soon as possible after removal from the oven.

Protect the winding from the wire by means of paper, cloth, or tape, and use the same or 25 per cent greater tension than that specified for final cold bands in the preceding article.

Complete Baking—Upon completion of the temporary banding operation, return the armature to the oven and bake until dry.

Final Cold Banding—After the armature has been baked dry and removed from the oven it should be allowed to cool; then all temporary bands should be removed and the final cold bands applied according to the directions in the preceding article.

The value of Method A lies in the application of varnish to the hot winding before pulling it up tight with bands, and then baking until the varnish becomes tacky. Thus, when the temporary bands are applied to a hot armature the windings are pulled up tight and the final baking cements the coils together.

On armatures using wire-wound coils having a large number of leads, it will be found advantageous to preheat the core and then to apply temporary core bands, omitting the dipping operation. After the armature has cooled connect the top leads; then follow Method A except in applying the temporary bands to the ends, allowing the core bands to remain. This method permits laying the top leads to better advantage, because it has been found in production work that when the armature is connected and the temporary bands are applied to the ends and core in one operation there is considerable slack in the leads, because the coils and front end have been pulled down.

Method B involves a somewhat shorter procedure that can be used for large armatures. The following operations are used from Method A: (1) Preheating. (4) Temporary banding. (2) Dipping and baking. (6) Final banding. Thus, in Method B the armature is dipped in varnish after the temporary bands have been applied, which means that before dipping the armature should be reheated if it has become cold during the application of the temporary bands.

Method C can be used to hot-band armatures that are not dipped and baked, and uses the following operations from Method A. (1) Preheating. (4) Temporary banding. (6) Final banding. In this method the armature is heated and temporary bands are applied to it while it is hot. It is then permitted to cool before removing the temporary bands and applying the final cold bands.

With Method C temporary core bands only can be applied before connecting the top leads; then the armature can be reheated and the temporary end bands applied, thus obtaining a neat and tight layer of top leads.

It will be found well worthwhile to establish the practice of hot banding armatures by one of the methods described, preferably in combination with dipping and baking, because movement of the winding during operation will thereby be reduced to the minimum, which adds greatly to its life.

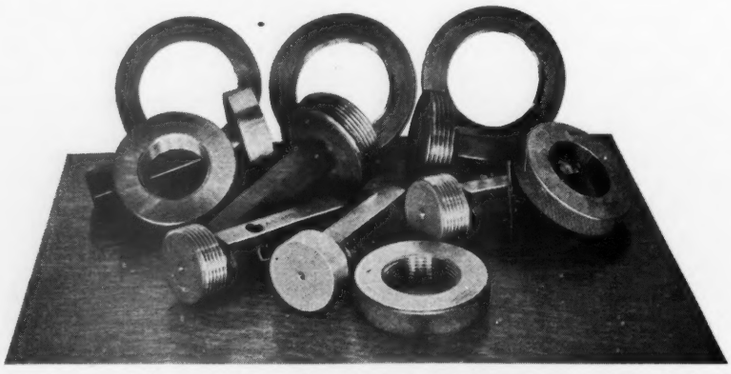
When applying temporary bands to hot armatures one should exercise care to prevent collapse of the coil ends and sagging of the layers of coil end, bearing in mind the fact that all sections of the winding are soft and pliable and, therefore, easily distorted. This means that armatures should be prepared from the core up for hot banding, by using a sufficient amount of the proper filling materials.

Planned Counter-Offensives Againt Fire

Continued from page 4

sprinkler alarm valves are to be inspected and tested at least once every month. The hydrants and alarm valves are all numbered. It is the duty of the fire department to become thoroughly acquainted with the numbering system and operation, as well as with all details of the sectionalizing control valves. For convenience a framed operating instruction card is placed at all sprinkler risers, showing the valve manipulation and the area covered by that particular riser. This procedure is followed at all of the sectionalizing valve pits and wherever else it may be required.

Floor space is valuable, and as it is necessary to maintain accessibility, particular attention was given to the riser locations. Risers are placed along aisles wherever possible in a place where they will be easily accessible and yet will not cause interference with traffic in manufacturing operations. Care is given to the proper sprinkler heads over ovens and other locations where the standard ordinary head is not suitable. Furthermore, no steam or hot pipes are located near a sprinkler head.



All hose couplings, nipples, play pipes, and hydrants passed the test of these gages. During construction each inspector was provided with a set of a "no go" plain gage and "go" and "no go" screw gages.

Application and Design of the Floating Drive for Conveyors

N. H. PREBLE
Detroit, Mich.

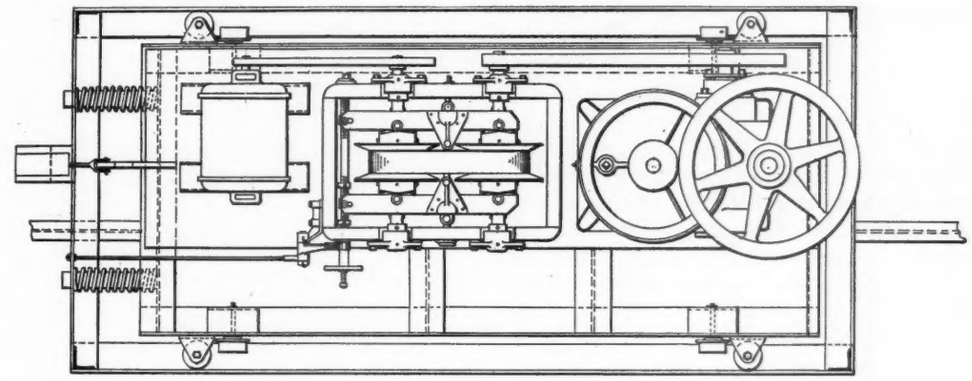
THE FLEXIBILITY of the single-chain overhead conveyor has made it especially adaptable for use in transporting and processing materials in mass production. But the length of conveyor that can be powered by a single, stationary drive is limited because the attendant increase in chain tension and friction necessitates prohibitive sizes of chain and supports.

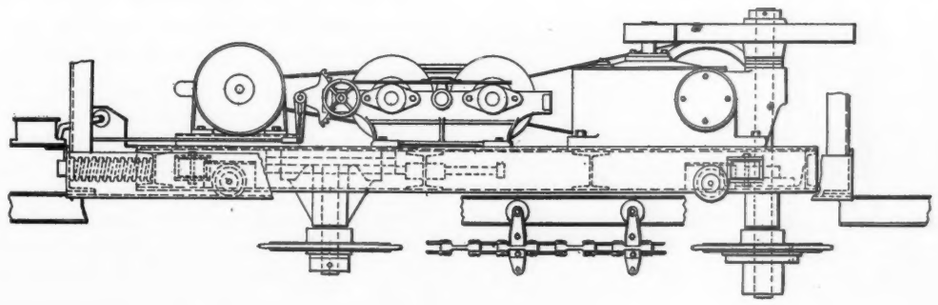
Increasing demand for longer and more heavily loaded conveyors has brought about the necessity for using multiple drives on a single strand of conveyor chain in order to keep the weight and cost of chain and carrier units down to a reasonable point. To meet this requirement there has been developed a floating type of driving mechanism so arranged that two or more drives located at considerable distances from each other will automatically synchronize as to speed so that a proper driving action at each drive point is maintained.

In order to operate satisfactorily the first essential of any multiple drive is that all driving points must be exactly synchronized. If one drive should be running only a very small fraction of a revolution per minute faster than the others it will tend quickly to pull the conveyor away from the other drives and assume the total load itself.

In the floating caterpillar drive illustrated the motor is connected by a silent chain or V-belt to a variable-speed transmission. The variable-speed shaft of the transmission is connected through a chain or direct through a flexible coupling to some form of reduction gearing, and the reduction gearing is in turn connected either direct or through separate gears to the driving head shaft. The driving sprocket operates a caterpillar chain drive which includes a take-up sprocket. All of these parts are mounted rigidly on the same frame. This frame is carried on rollers and guided within a secondary frame by means of vertical rollers. As the caterpillar chain operates in a direction parallel to the driven conveyor chain the reaction of the drive effort on the conveyor chain will move the frame parallel to the conveyor. This movement is counteracted by a pair of coil springs attached to the fixed frame and bearing against the floating frame. The strength of these springs is adjusted to counterbalance properly the calculated chain tension at the individual drive.

It is at once apparent that if the chain tension or driving effort goes above the calculated figure, the coil springs will be compressed beyond their normal position, and vice versa. This tendency to movement is the operating medium of the speed control. The adjusting shaft of the variable-speed transmission is connected to the fixed frame through a series of gears and levers so that, if the drive moves back under excessive load, it will be automatically slowed down, and vice versa. The design of the connection between the fixed frame and the adjustment shaft of the speed transmission is arranged so that the sensitivity of the control may be adjusted by varying the length of the lever arm.





(Abstract of paper presented before the American Society of Mechanical Engineers, Dec., 1931)

PLANT ENGINEERS' FORUM

A new question is presented each month, and our readers' answers to previous questions are published. Write down your opinions and send them to the editor. Answers published will be paid for

How Valuable Are Professional Plant Surveys?

New Year's afternoon finds the George Shipmans entertaining their friends at an informal reception and, of course, Frank Fulleger and his wife are there. As the scene opens Frank and George have retreated to the kitchen supposedly to help with the refreshments, but they seem to be doing more talking than assisting.

* * *

"No depression in this house, Frank. If everyone is as cheerful this year as the bunch in there, business will be back with a bang!"

"Right you are, George. Maybe it's a tribute to your hospitality. Certainly is a swell party."

"Thanks, Frank. By the way, I dropped around to see you a few days ago at the plant but you were all tied up in a conference. What's up?"

"Bunch of high-pressure engineers from the Century Oil Company sold the boss the idea that they could cut our lubrication and maintenance costs if he let them survey our plant lubrication. My part of the job has been to show them around and answer their fool questions. It sure has kept me busy."

"Don't like the idea, do you, Frank?"

"Waste of time and energy, George. I've lived with the equipment in our plant for years, studied and experimented to find the best method of lubricating each type of equipment. How can these fellows from outside come into my plant and find out how to better my methods in a couple of days?"

"Maybe they can't, Frank, but isn't it a good idea to let them finish the job before you pass judgment?"

"Suppose you're right, George. Maybe the boss did it to check me up. As usual you've brought me down a peg or two."

"Wouldn't feel that way, Frank. Why, the best of us—gosh, we'd better pass the ice cream around or it will melt. Then we would catch it!"

* * *

And so terminates our characters' discussion of a problem that undoubtedly has confronted most of the readers of MAINTENANCE ENGINEERING *at some time or other. You, who have had experience with this problem, must have formulated definite opinions on the subject. Put them on paper and send them to the editors.*

Are plant surveys by the engineers of outside firms a profitable and feasible procedure?

In addition to the lubrication survey given as an example in the dialogue the question, of course, refers to all other types of surveys, such as may be performed by the engineers of wage-payment, industrial-engineering, heating-and-ventilating, materials-handling, power-transmission, industrial-instrument, and illumination concerns.

Readers' Answers to Previous Questions

A Reserve Fund for Maintenance?

(Question presented in the December issue)

TO INSTITUTE such a fund is a laudable objective indeed from the plant engineer's point of view, but it is not one that would be thought practical by accountants, industrial engineers, or management in general.

This subject reminds me of the household savings problem in which money is set aside for purposes other than actual running expenses, such as savings accounts. Everything runs smoothly until a real emergency comes, when it is found that the savings have had to be used for other purposes.

Because any reserve fund is no more than a savings fund I see no reason why a maintenance reserve would fare any better than household savings. By the time a real emergency arose, the maintenance reserve fund would have been spent to buy new equipment or to pay dividends in a pinch. The emergency would have to be met in any event; therefore I cannot see what difference the name of the fund makes. If a company is doing well it can afford to fix up its equipment but, if all it can do is to keep going, everything must suffer —the price of its stock, wages, dividends, and maintenance—regardless of the fact that money exists in an account for maintenance.

I realize that this viewpoint is not ideal, but I believe that it is practical. We all know that, when our shoes are wearing out, we either ought to have them repaired or buy new ones. If we cannot afford either alternative or need the money for other purposes we have to get on as well as we can. But, if we can afford to pay for one or the other, we do so and it makes no difference what the name of the fund is that pays the bill.

JOHN S. ISDALE, *Plant Engineer*
Factory K, International Silver Company
Meriden, Conn.

STABILIZED employment, budgeting, and scheduling are among the chief topics of industrial discussion in these days. They are recognized to be of prime importance in performing the job of getting through these hard times in an economical way and, at the same time, maintaining the peace of mind of employees. If the maintenance engineer is to be successful in cutting costs he should be allowed full use of the foregoing three tools. At no time have maintenance costs been studied by management as much as in the present time.

By establishing a reserve for maintenance projects the engineer can so schedule the work that his force is kept busy at all times, thus removing the opportunity to stall on the part of his force. If the maintenance men know that they have steady jobs they will work faster, more efficiently, and with less supervision than if they were afraid of losing their jobs.

Unless the maintenance engineer knows in advance how much management will spend on maintenance he cannot schedule his work intelligently and, without efficient scheduling, the benefits of stabilized employment cannot be secured. Therefore a reserve should be set aside for sound maintenance projects.

The reserve should be so tied in with the depreciation account that, when machines and buildings are reconditioned, the attendant increase in the life of such equipment can be capitalized by crediting the maintenance reserve fund with the corresponding decrease in the amount of the depreciation reserve necessary to replace the equipment. For example, if a machine that cost $7,500 has been used for 10 yr. of its estimated 15-yr. life, $5,000 should be in the depreciation reserve. But suppose that by overhauling the machine at present low material and labor costs, 5 yr. are added to its expected life. Then $2,500 can be taken from the depreciation reserve account and added to the maintenance reserve fund.

BERNARD SHEREFF, *Engineer, Standards Department*
American Hard Rubber Company
College Point, L. I.

THE IDEA of a reserve fund for purchasing new and modernizing existing equipment has possibilities that no plant engineer can afford to overlook during such periods as the present when cost departments are showing a reluctance to loosen the purse strings.

In the first place it is obvious to all of us that we have at present a buyer's market in the equipment field and that prices are unlikely to go below the present level. Indeed, with the expected upswing of the business pendulum, they may go higher. I am convinced, therefore, that it is the duty of every maintenance engineer to check up on each piece of equipment and compare its efficiency with that of the latest models. In the majority of cases this comparison will enable him to present a clear cut argument in favor of a reserve fund.

Where modern equipment has been installed recently careful and intelligent planning will enable the engineer to build up a reserve fund with the savings effected by the new equipment. Such a task should not be difficult in plants that use a system of yearly budgeting.

By scheduled inspection and careful attention to minor details of maintenance, such as oiling and bearing adjustments, major breakdowns can be averted and labor and material costs reduced. The resulting savings form an excellent argument for the creation of an equipment reserve fund.

ROBERT S. ALEXANDER, *Special Department*
Universal Winding Company
Auburn, R. I.

Is There Profit in Spending?

(Question presented in the November issue)

YOUR question interested me greatly because a short time ago we had to decide what to do in just such an issue. Because we do not have a large business our expenditures are, of course, not very great when compared with those of a big corporation. But we operate

HOWARD W. HARPER
Assistant Chief Electrician, American Tube and Stamping Plant, The Stanley Works, Bridgeport, Conn., a contributor to the Forum.

on a smaller margin of profit than many large plants and in times like these we have even worked at a loss. Such a losing game might have continued up to the present time had we not taken drastic measures to remedy it.

We called a meeting of everyone connected with the business to discuss the situation. In this meeting we decided to institute the following three-point program: (1) house-to-house canvassing, (2) new and more progressive advertising campaigns, (3) the purchase of new equipment.

The first two points met with no opposition, but we argued a great deal over the third. Many insisted that new equipment could not help us in any way. I maintained then as I do now that judicious purchasing can be very profitable. We were badly in need of several hundred dollars worth of new equipment. Because at that time business was at its worst it is not surprising that it seemed a foolhardy venture to invest such a sum of money in a project that already was "in the red." Yet, after a great deal of discussion, I finally prevailed on the others to permit me to make the needed purchases.

After investigating all markets I purchased only the best of equipment. Consequently, with prices at their lowest point in history, I was able to buy superior quality at bargain prices.

The result? Business has picked up 100 per cent. While others are deep in the rut of depression our profits have shot up higher than in prosperity times merely because we have learned how to buy. Our order department now brings in a volume of orders that would require more than three times the capacity of our former equipment to convert them into our products which consist of paints, oils, varnishes, brushes, and alcohol. The new equipment has all it can do to keep up with our orders. Because the equipment has paid for itself long ago it is adding to profits constantly.

I can see no reason, therefore, why a larger establishment cannot duplicate what has been done in our small business.

Just to mention a few of the many possibilities of new equipment: A leading magazine recently published an article describing machines the moving parts of which are painted in colors that help to eliminate accidents. Poor lighting causes work to be done inefficiently. Good lighting systems now are on the market at a very low cost. New cables, elevators, trucks, and cranes can help to reduce accident losses while speeding up production and distribution.

I am certain that, if employers in general would follow our example, they would find that judicious buying saves money. Moreover almost every piece of new equipment will aid in saving a worker's life or limbs. In any case the only way to prove that it can or cannot be done is to try it. How pleasantly surprised you will all be when you succeed! We have. Why can't you?

In brief, money spent for new equipment or renewed equipment is money saved because it brings in higher profits at a lower operating cost.

I. TANENBAUM, *Manager*
Tanenbaum and Son Oil Company
Cleveland, Ohio

ECONOMY should be practiced in and out of season. But, in this particular season, economy often takes the misguided course of complete curtailment of expenditures. Such a course is fundamentally unsound for any plant that has prospects of continuing as a going concern.

It is not surprising that many proposed expenditures are ruled out because the benefits to be gained are problematical. Most maintenance problems, however, are susceptible enough of engineering analysis so that a definite summary can be made of the cost of rehabilitation on one hand and the cost of non-spending on the other.

A recent overhaul of a deep well pump indicated that its bearing design was faulty and other minor features of its construction were not suited to the conditions under which it was operating. It was decided that it would be much cheaper in the long run to alter the design of the pump to suit conditions than simply to replace the necessary parts, even though such alterations cost more.

In comparing the notes of men who have partially abandoned preventive maintenance policies with those who adhere to regular dismantling and replacement of equipment and parts found worn or damaged, it appears that the total cost of doing business for the year is considerably higher for those who cut expenditures for maintenance. Experience has indicated that patchwork in maintenance seldom pays dividends.

J. ELMER HOUSLEY, *Electrical Superintendent*
Aluminum Company of America
Alcoa, Tenn.

THE PROBLEM of modernizing factory equipment is of utmost importance and should not be overlooked. I believe that it often is possible through careful purchasing to supplant obsolete machinery with new and, within a short time, to receive a substantial profit from the money spent.

Some time ago a factory installed a home-made mechanical dryer which was soon proved to be inefficient and impractical. Consequently it was decided to scrap this makeshift and purchase a high-speed, conveyor-type of dryer. The money spent is bringing in a steady, substantial profit because the new equipment cut the process time in half and bettered the quality of the company's product.

This line of reasoning can be applied to many standard types of machines, the modern designs of which have increased the speeds and feeds to such an extent

that it is not practical to maintain and use the older, obsolete models. It often has been possible to prove the advisability of purchasing modern equipment by showing that it can pay for itself within a reasonable time by means of a comparison of the quality and quantity of products produced on the existing machinery with those expected of the proposed new equipment. Money spent for modernizing machinery in these times of advantageous buying will be repaid many times over when production is increased.

K. D. HAMILTON, *Mechanical Department*
Geo. E. Keith Company, Campello, Brockton, Mass.

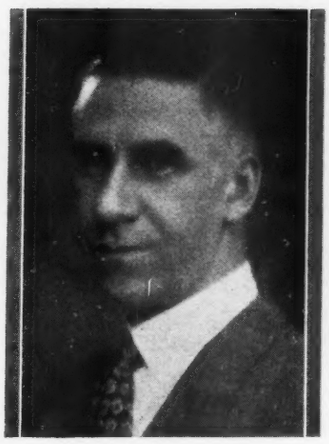
Interviewing Salesmen

(Question presented in the October issue)

UNLESS there is some likelihood of an early purchase an engineer should not interview salesmen. A salesman would not call unless he believed that there was an opportunity to make a sale; therefore it is unfair to rob him of his time when it is known that no purchase can result from the interview. Salesmen seem willing to tell their stories to anyone because they seldom know for sure whether or not a person is a prospective customer.

Salesmen whom the engineer does not wish to interview should not be kept waiting. One way to keep such salesmen from returning too soon is to tell them that, although no purchases in their line are contemplated at the time, their printed matter is desired for reference. This procedure may lead to the receipt of much advertising mail, but an abundance of literature is less of a problem than useless personal interviews. Furthermore the literature is a good source of information about new developments.

After the engineer has eliminated all superfluous interviews by this method it is possible for him to spend more time with the salesmen of products in which he is interested. As soon as the trend of the discussion shows that a prolonged interview is useless the salesman should be told of it with the reason. If the price, for example, is high and cannot be lowered the interview should be ended. Why discuss as a possible purchase a product that the prospect cannot afford? Under such objectionable circumstances it is as much a waste of time to listen to detailed sales stories as to listen to the clock tick.



JOHN S. ISDALE

Plant Engineer, Factory K, International Silver Company, Meriden, Conn., gives his reasons in this issue for questioning the feasibility of a reserve fund for maintenance.

Salesmen should be treated courteously at all times. They are not to be considered as beggars for they offer a fair exchange of their time and knowledge for the engineers' attention.

BERNARD SHEREFF, *Engineer, Standards Department*
American Hard Rubber Company
College Point, L. I.

THE question of interviewing salesmen was brought up for discussion by the management of one of our local corporations, and it finally was answered by what I consider to be as perfect a solution as possible.

The system now in operation follows: All salesmen are interviewed for a period at least long enough to find out what they have to offer—if only from a point of politeness. It is then the duty of the engineer to get rid of salesmen whose propositions do not interest him. Such a task can be accomplished with suavity and diplomacy by a man who is worthy of his engineering position.

On the date that the plan went into force, cards were given to the salesmen as they called. Upon the cards was stated that the plant engineer would interview salesmen only during the specific daily hours indicated. The salesmen now plan their calls to suit these visting hours. After a few months' trial results of the system have been a minimum of lost time for the engineer and the good will of the salesmen.

Any policy or system used must be fair to the caller as well as to the company if the good will of the sales representatives—an important asset—is to be maintained.

CHARLES R. WHITEHOUSE, *Standards Department*
The Holtzer-Cabot Electric Company
Boston, Mass.

IN DISCUSSING the problem presented for October with a number of engineers I find that there is no hard and fast rule as to the amount of time that should be given to a salesman. In some cases the personality of the salesman was admitted to be a dominating factor in determining the time of the interview, whereas in others the length of the interview was fixed by the time requirements of the purchasing agent or engineer. One conversation brought to light a practical plan of campaign which was evolved by a purchasing agent of many years' experience. In my opinion its very simplicity makes it worth the consideration of any engineer who has the responsibility of ordering new equipment.

My informant told me that a decade or two ago his knowledge of a firm's products was limited strictly by his experience and contact with its salesman. But, by reading the advertisements of technical journals with their modern methods of presenting information on the various engineering products by attractive illustration and clear cut, convincing wording, he was able to reduce his interviewing time considerably. By studying the journal best suited to his needs he was able to select three or four reliable makers of whatever equipment he required. By querying these manufacturers for further data he obtained all the information necessary so that, when a salesman called, a minimum of time was spent in the interview.

ROBERT S. ALEXANDER, *Special Department*
Universal Winding Company
Auburn, R. I.

A specific electric heat application in severe foundry service is tried out as an experiment and retained as good practice

ELECTRIC HEAT SOLVES A FOUNDRY PROBLEM

WM. B. FERGUSON

Works Electrical Engineer
Westinghouse Air Brake Company
Wilmerding, Pa.

MUCH has been said from time to time about the different types of heating by means of electrical methods, but little information of value has been produced pertaining to the use of electric heat for foundry applications, where the severe service demands special design.

There may not be any demand for electric heaters in most foundries; but because we have found them very helpful and economical, I am giving this outline of our heater experiments. I feel that the application of electric heat in the foundry is a little out of the ordinary, probably owing to the fact that most foundries are subject to dirt and other conditions which are impossible of correction.

Four years ago the foundry superintendent asked if we couldn't provide him with some kind of electric heaters for the molding machines to heat the patterns, so that the molding sand would not stick firmly to them.

We first started with the Nichols jar type of molding machine. Our experiments were begun on equipment in severe service, because if a heater would stand up under the jarring service it would easily stand the ordinary squeeze service of the other types of machines used in the plant.

Our first trial was with space heaters of the conventional type. It was found that they did not give satisfactory heat distribution. Furthermore, they were not easily adapted to the patterns.

Next we tried imbedding a standard heating element in a mixture of

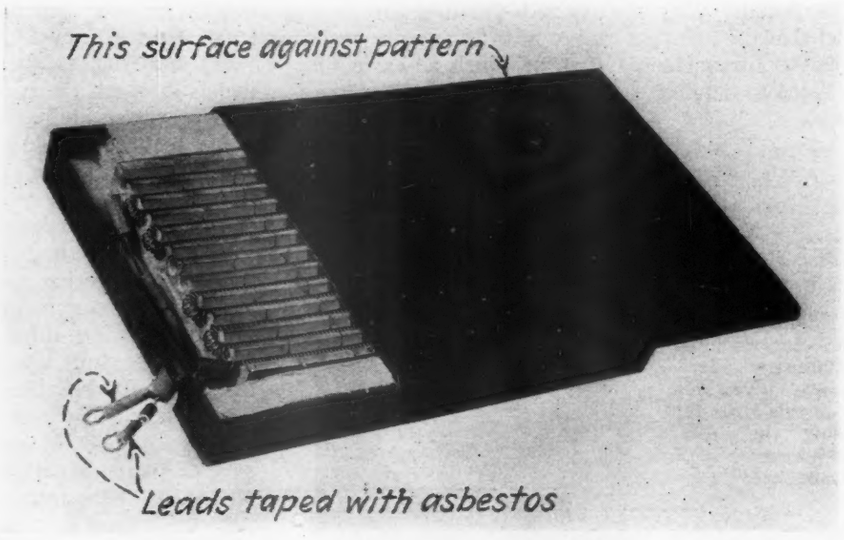


Fig. 1—Type of heater used for all flat-bottomed patterns. With a capacity of 1,300 watts, a plate temperature up to 125 deg. F. is obtained.

asbestos and silicate of soda, the whole being contained in a suitable pan. This method did not work out very well because the insulating compound would dry out and crumble, allowing the heating element to be exposed and subsequently damaged.

Some time later, while tearing down a solid pot, we salvaged some of the porcelain bricks, and made our next heater of the proper number of bricks to fit the pattern. These bricks held up fairly well despite excessive breakage.

After operating with this type of heater for some time we discovered the reason for the breakage. The powdered asbestos used in packing the bricks in the pan would pulverize, because of the jarring action. This disintegration permitted the bricks to move around and be broken, again allowing the element to be exposed and subsequently destroyed.

As a result of these troubles we adopted a construction using a pan, as shown in Fig. 1, which is made of 16-gage iron. Four layers of sheet asbestos (total thickness about $\frac{1}{4}$ in.) were then laid on the bottom of the pan. The heating element was set in on top of the asbestos with the open side up. We then packed the sides with asbestos strips 1 in. wide.

The important point in connection with the construction of these heaters was to have the asbestos at the bottom of the pan of the proper thickness so as to throw the top of the bricks about $\frac{1}{8}$ in. above the level of the pan container. This feature is essential. The pattern plate, when placed on top of of the heater, must press firmly against the bricks, holding the heating element tightly against the asbestos backing. In this way we avoided breaking the bricks.

Our first pans were made with open tops, a distinct mistake, for in nearly every case a heater failure was traced to carelessness in handling. The type of workman in the average foundry is not always the best or most careful, so provisions had to be made to eliminate the breakage due to handling.

All our present pans have sliding tops which fit snugly against the porcelain bricks and prevent them from moving within the pan. Because it is in close contact with the pattern, the heater will transmit nearly all the heat with very little loss.

Nearly all the heaters of the flat type are rated at 1,300 watts. They maintain a plate temperature of approximately 110 to 125 deg. F. while working, which is sufficient to keep the damp sand from sticking to the pattern. Without sand on the patterns the temperature will vary between 250 and 300 deg. F. On test, one plate (dry) went from 67 to 250 deg. F. in exactly 30 minutes. Although rated at approximately 1,300 watts the heaters varied in some cases; the wattage varying from 5 to 10 watts per sq.in. of heater surface, depending upon the mass of metal on the pattern face.

In the case of some of the round-type heaters it was necessary to parallel two units in the same pan in order to get the desired heat, but there again it was a matter of cut and try.

At each molding machine there is mounted a convenience outlet, and each heater has a cord of sufficient length so that it may be plugged in or disconnected with ease.

Other types of heaters are shown in Figs. 2 and 3, in which the solder pot bricks and elements serve our purpose satisfactorily. In Fig. 2 is shown the construction of the pan, and in Fig. 3 a completely assembled pan less the cord.

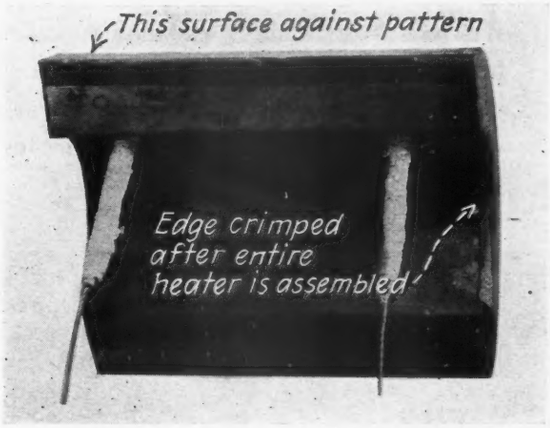


Fig. 3—Heater pan assembled except for the connecting cord. The edges are crimped together to form a dustproof container.

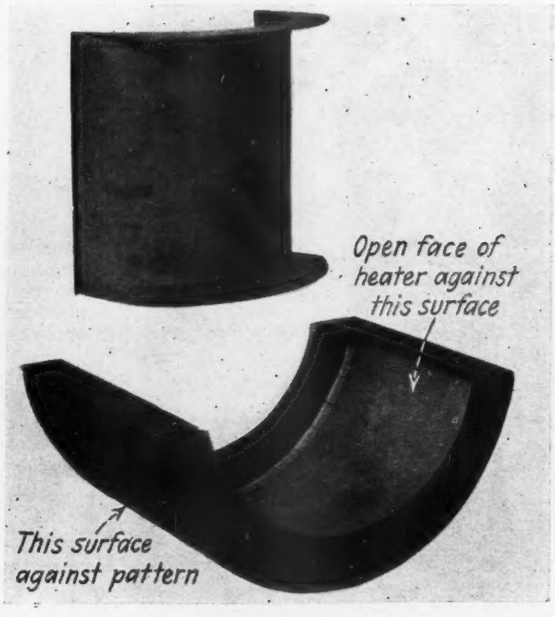


Fig. 2—Construction details of round-type heater for cross-compound pump patterns.

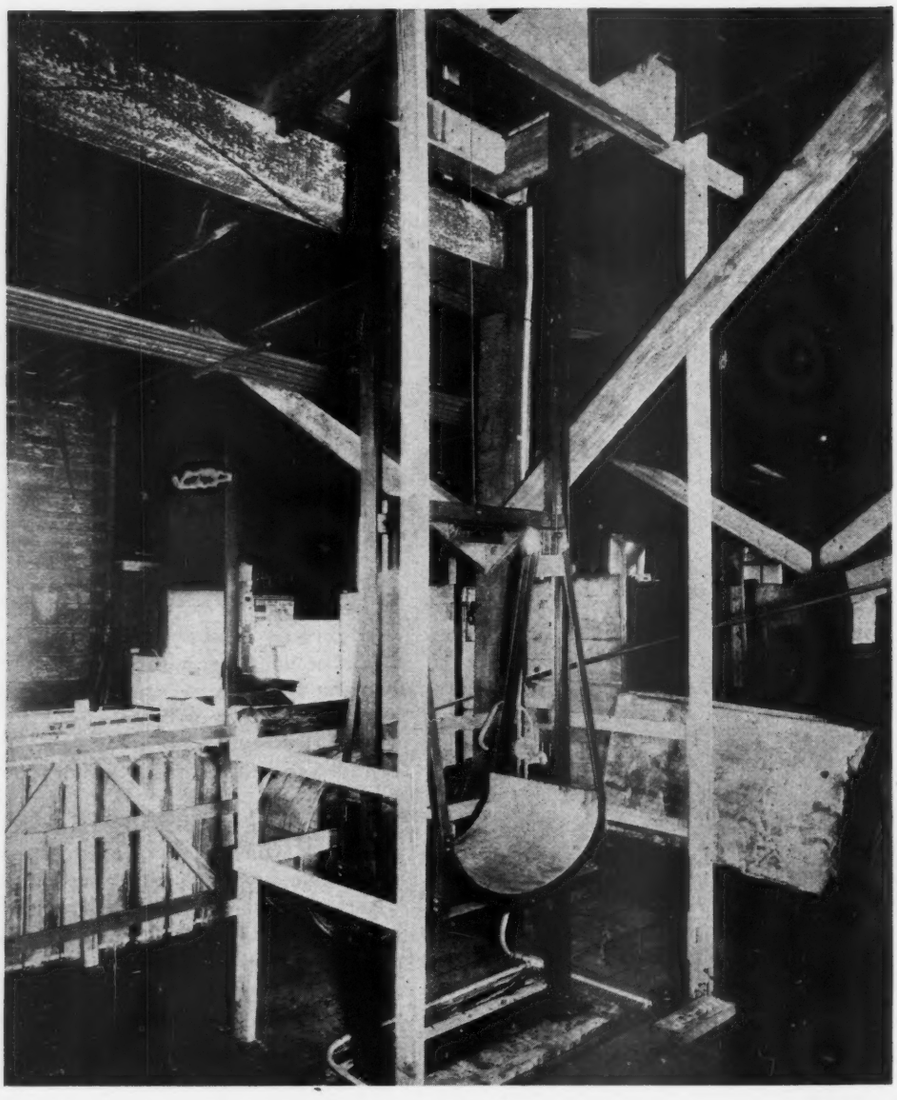
This round-type heater is used to heat the cross compound pump patterns, where a large and a small unit are required, the elements in both cases being arranged so that the open or heating side of the brick faces the outside surface of the pans.

In this type of heater the bricks are used directly against the front surface as in the flat type, with sheet asbestos backing and side packing. The inner surface of the pan is inserted, after which the two sides are riveted or crimped together to form a dustproof box.

These heaters are used on a traveling truck which supports the pattern, the whole arrangement being pulled after a traveling type of molding machine. It is necessary that a three-wire cable be used to energize the heating elements, the extra wire supplying a solid ground, because there is no effective connection between ground and pattern buggy.

Small Applications of Handling Equipment

Large, intricate systems always have received the lion's share of the publicity given to materials handling equipment, even when it has been known that the potential users of small installations outnumber greatly those of the big, more impressive systems. The result is that undiscovered opportunities for the economical application of materials handling equipment in a small way exist today in many plants. Here we show examples of small installations doing good jobs.

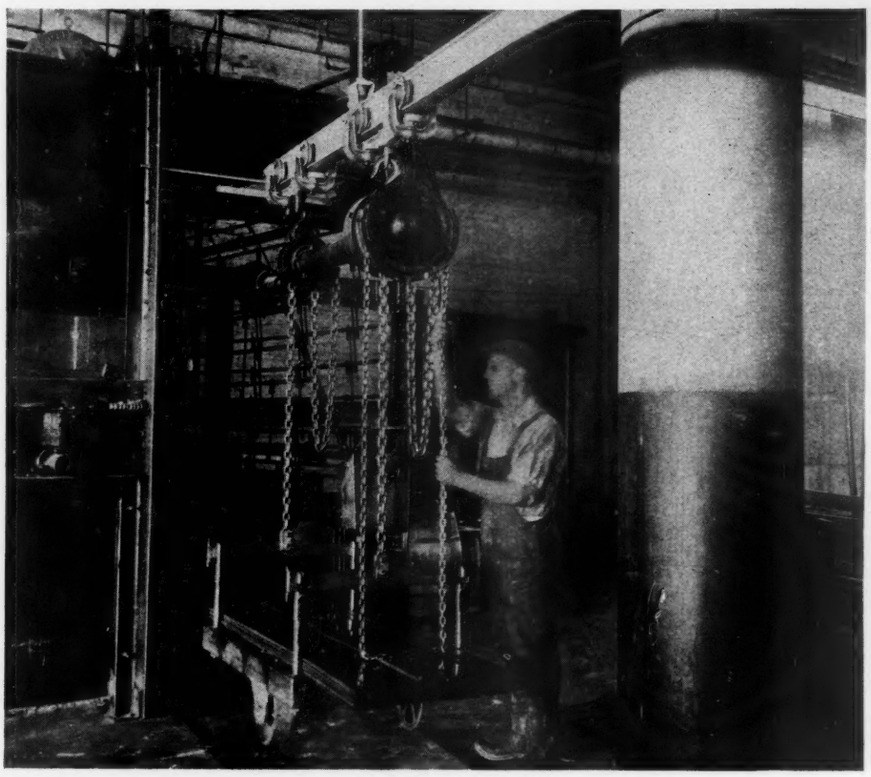


Costs of handling seed corn in the plant of Morgan Brothers, Galva, Ill., have been reduced considerably by the introduction of modern equipment. Shown is the start of a monorail system used to remove 800-lb., welded-steel containers of seed corn from wagons and to distribute the corn into drying bins. A motor driven tractor unit equipped with an operator's platform has been added to the ½-ton electric hoist.

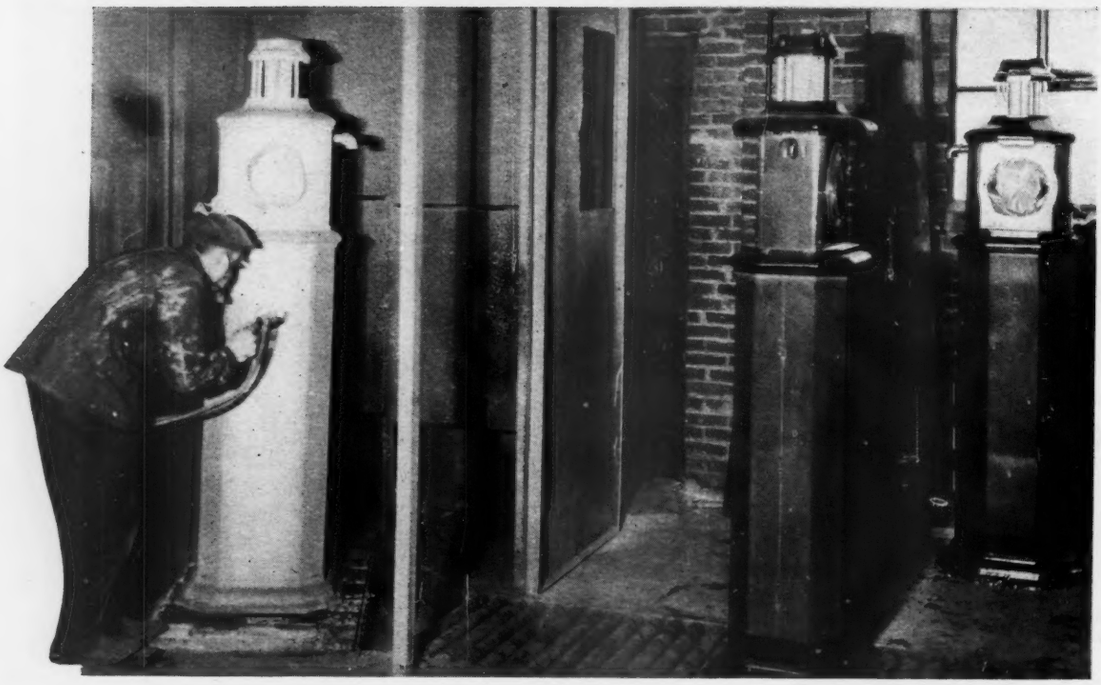
A simple reciprocating elevator controlled by foot type pushbuttons does an economical job of transporting batches of tobacco between floors in the plant of the Tobacco Rehandling Company, Louisville, Ky. The carriage is moved along the guides by an electric hoist.

Customers' orders do not lie on desks waiting for the messenger boy in the plant of Jos. T. Ryerson, Inc., Chicago, Ill. A belt conveyor whisks them from the telephone order clerks shown in the illustration through the order editors to the service department in 10 min.—a fraction of the time formerly necessary.

Unusual flexibility in handling steel sheets between pickling operations and punch presses or storage is obtained in the plant of the Appleton Electric Company, Chicago, Ill., by means of a combined push truck, 3-ton double-tandem hand hoist, and a monorail system. The push truck is disengaged from the remainder of the equipment to serve areas not covered by the monorail.



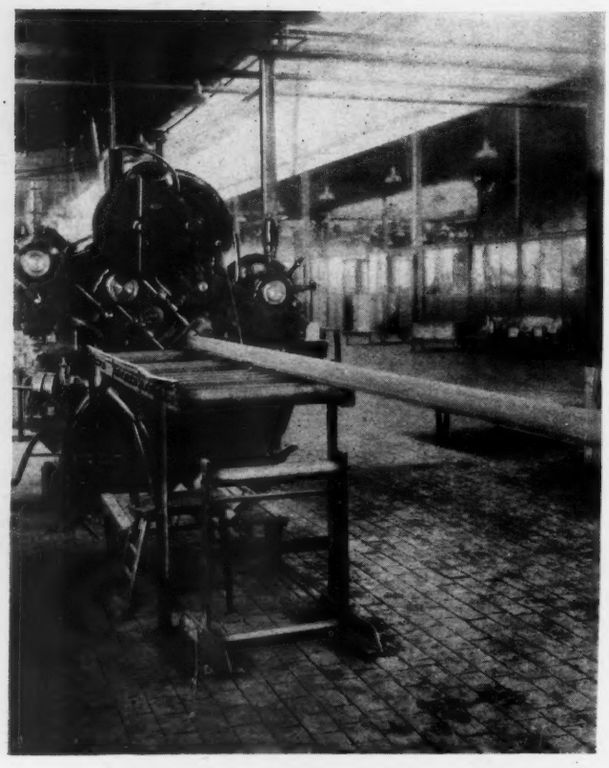
Bags of feed may be carried from the warehouse to the freight cars or vice versa, as well as between any two points within the warehouse, by means of a reversible drag conveyor and a portable piler in the plant of the Eastern States Milling Corporation, Buffalo, N. Y. By locating the drag conveyor against the wall, floors are kept free from obstruction.



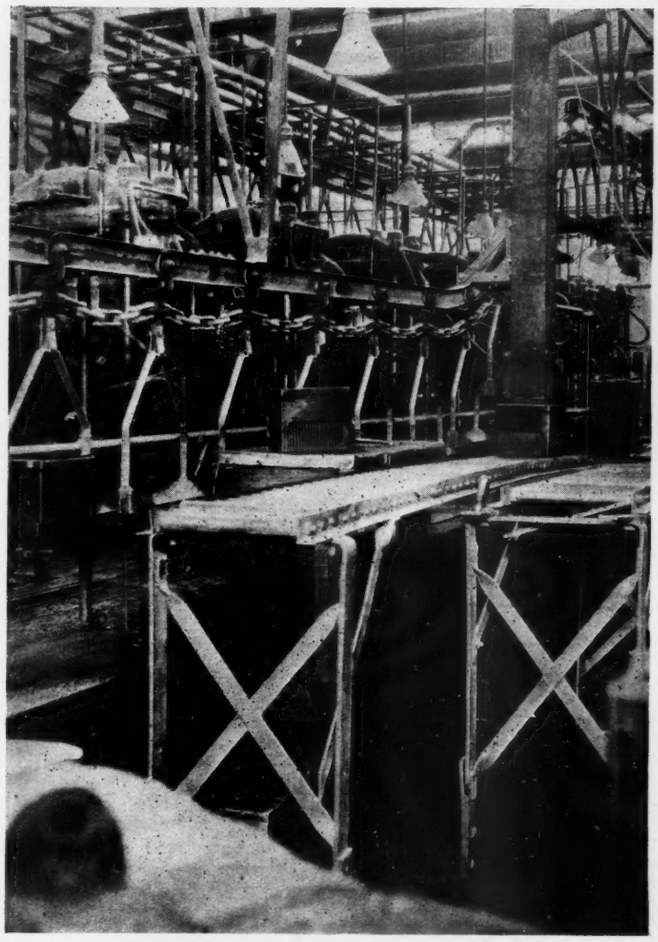
Gasoline pumps roll through spray booths in the plant of The Pennsylvania Pump Company, Pittsburgh, Pa., on a gravity roller conveyor. A roller turntable built into the conveyor line within the spray booth permits the pumps to be rotated as desired during spraying.

Waste in every conceivable form—small and large baskets, boxes, bundles and bags—is carried between the trucking floor and the waste house above in the plant of the Dwight Manufacturing Company, Somersworth, N. H., on a wood-slat conveyor equipped with angle-iron stop bars. Operation of a reversing switch changes the direction of material flow.

It's only a few feet of roller conveyor, but without it an extra man would be necessary to feed steel angles into a shear in the plant of The Walker Vehicle Company, Chicago, Illinois.

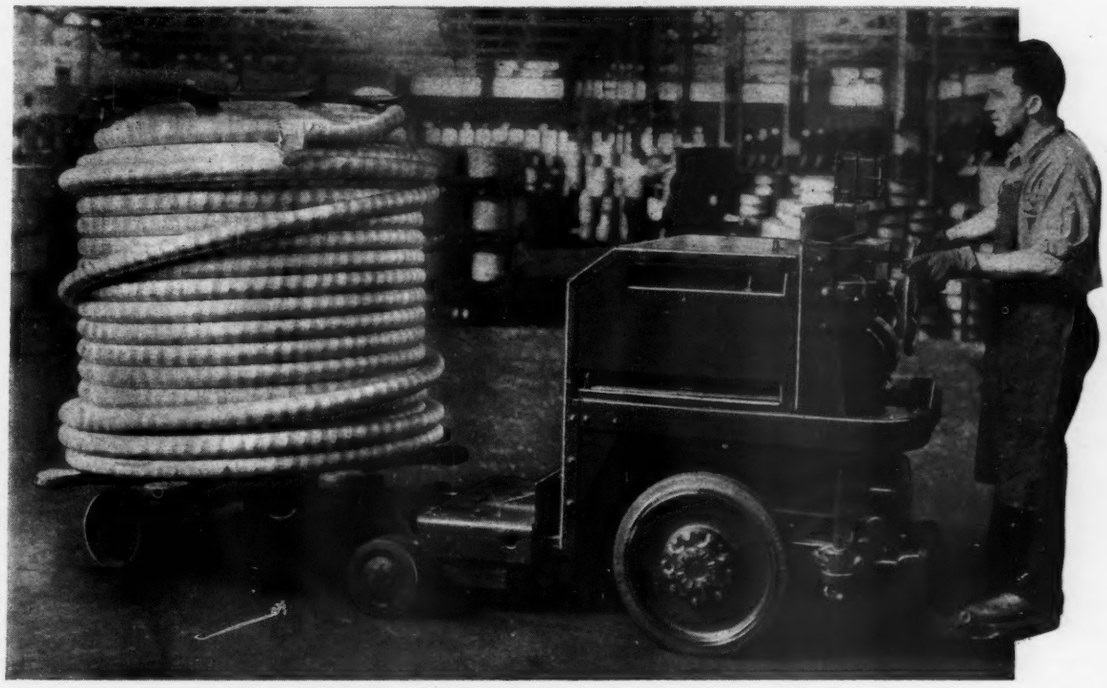


Battery cases are carried from the forming presses to the inspector's table at the plant of the U.S.L. Battery Corporation, Niagara Falls, N. Y., by means of an overhead trolley conveyor. The equipment, beside eliminating unnecessary steps, insures an even flow of cooled cases to the inspector.



Socket assembly costs were reduced 35 per cent in the plant of the Benjamin Electric Company, Des Plaines, Ill., by the introduction of progressive assembly methods by means of a belt conveyor. Wood lanes are arranged so that one lane leads to each worker.

Development of a special electric truck to haul three-wheel cable-core trucks between stranding machines and vacuum dryers in the Hawthorne Works of the Western Electric Company, Chicago, Ill., obviated the necessity of scrapping the cable-core trucks formerly used as hand trucks. The electric truck is equipped with jaws which grip the axles of the single swivel casters of the cable trucks and raise them off the floor.



Power Analysis in High-Speed Group Drives

ROBERT W. DRAKE

Mechanical and Electrical Engineer
Chicago, Ill.

IN THE initial article of this series, in the October issue, it was pointed out that there are several advantages in using higher groupshaft speeds in group drives for high-speed machines.

For example, in driving a group of machines having driven pulley speeds of, say, 1,000 r.p.m., we are accustomed to start with a motor operating at 900 r.p.m. or even 1,200 r.p.m., reduce the speed to between 200 and 400 r.p.m., through a belt drive of unfavorable pulley ratio, and then increase the speed again. If a countershaft is used this increase may be in two steps, with fairly good pulley ratios; if no countershaft would otherwise be required, it is necessary to use one, or else employ another belt drive with unfavorable pulley ratio.

To one unacquainted with tradition it might seem odd that we do not operate groupshafts at a speed intermediate between motor speeds and machine speeds. For groups of machines with driven pulleys turning at 1,000 r.p.m. or so, such practice would have several advantages.

1. All pulley ratios would be improved. Belt tension necessary would be less, slip losses decreased, and machine output increased.

2. With present lineshaft speeds, belt speeds are generally kept, by consideration of pulley sizes, far below their most economical value. With higher groupshaft speeds, this limitation would be removed.

3. The cost of overhead transmission would be decidedly less. Smaller shafting could be used, with smaller and narrower pulleys, and narrower

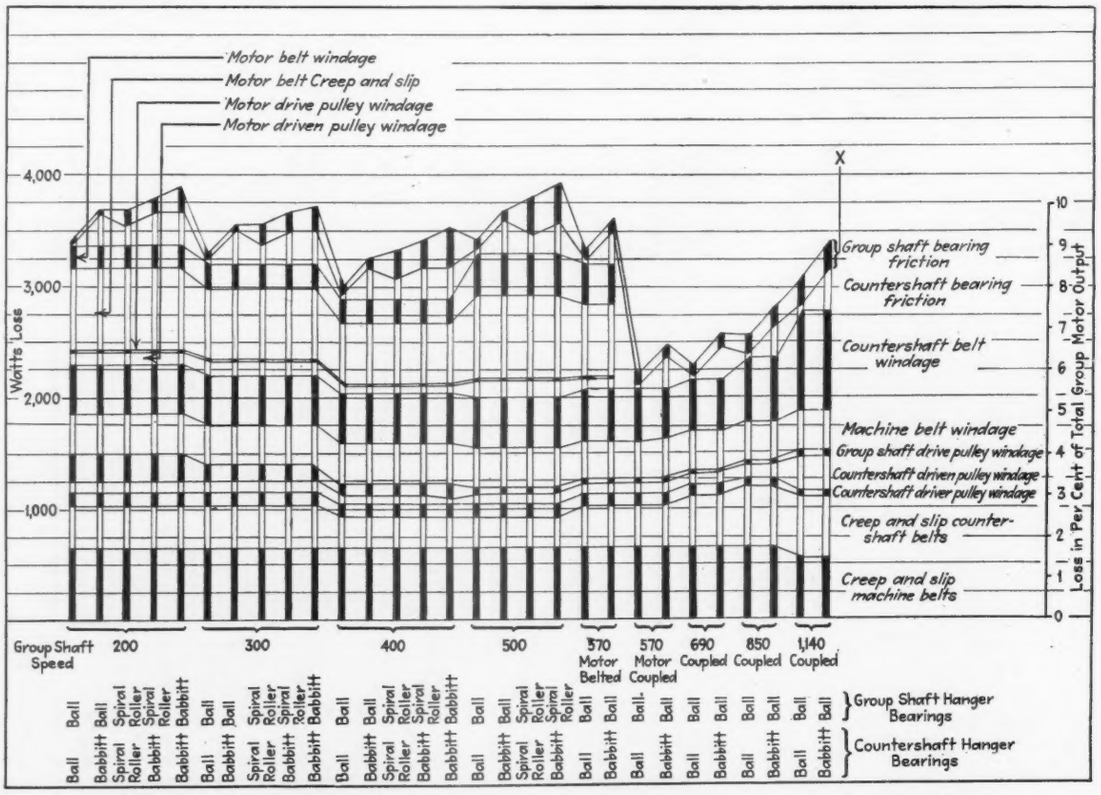


Fig. 1—Analysis of group drive transmission losses for a battery of eight machines driven from a lineshaft 80 ft. long by a 50-hp. motor. For groupshaft speeds of 570 r.p.m. and below countershafts are used, with all countershaft belts running 2,500 f.p.m. Direct connection of motor and groupshaft is assumed for speeds above 570 r.p.m. The length of the light and dark areas inclosed by the vertical lines represents the designated losses in watts, each division being equal to 250 watts. The total length of the vertical light and dark areas is the total of the various losses under the conditions indicated; hence, the bottom of each light or dark space represents its zero point. For example, the length of the dark area marked X, representing the groupshaft bearing friction loss at 1,140 r.p.m., indicates a loss of 240 watts.

belts. For the highest speeds, ball-bearing hangers would be required; for intermediate speeds there would be available high-grade babbitt bearings, spiral, and tapered roller bearings, and ball bearings. Ball-bearing hangers are well within their inherent limitations at any speed that is likely to be otherwise desirable, say, 1,200 r.p.m. or less. Even 1,800-r.p.m. groups are practicable for small and moderate horsepower requirements.

Consideration of the possible disadvantages of higher groupshaft speeds showed that for groups involving high-speed machines, the only important limitation was a possible increase in mechanical transmission losses.

operating cycle of a few seconds. Suppose the load on the motor averages around 50 hp., but may reach 60 to 65 hp. for several hours.

Then a 50-hp., 40 deg. motor will be used.

The sizes and cost of the mechanical transmission elements selected will vary with the speed. Groupshafts range from $2\frac{7}{16}$ in. and $2\frac{15}{16}$ in. in diameter at 200 r.p.m. to $1\frac{11}{16}$ in. at 1,140 r.p.m. At several speeds below 700 r.p.m. a section of larger shafting is used at the motor drive, with smaller shafting elsewhere. The groupshaft is 80 ft. long, with nine or ten hangers for the larger shafting, and fourteen hangers for the smallest shafting—on the 1,140-r.p.m. drive. For belted drives motor speeds are:

shaft and the countershafts. Cast-iron pulleys are more commonly used on countershafts; however, the windage losses of cast-iron pulleys exceed the corresponding losses of these particular steel pulleys by amounts varying from 70 per cent for pulleys one diameter wide to 800 per cent for pulleys that are narrow in comparison with their diameter.

Inasmuch as low-loss pulleys were used on the highest-speed drives, a fair comparison demands their use on the lower-speed drives. If types of pulleys, bearings, etc., are changed as the speed is increased there will be doubt as to whether any change in losses is due to the change in speed, or to change in type of equipment.

Speeds for the countershaft belts

TABLE I — TRANSMISSION EQUIPMENT REQUIRED FOR GIVEN DRIVE AT DIFFERENT GROUPSHAFT SPEEDS

Groupshaft speed, r.p.m.	200	300	400	500	570	690	850	1,140
Groupshaft, diameter, in.	$2\frac{15}{16}$* and $2\frac{7}{16}$	$2\frac{7}{16}$	$2\frac{7}{16}$* and $2\frac{3}{16}$	$2\frac{7}{16}$* and $2\frac{3}{16}$	$2\frac{7}{16}$* and $1\frac{15}{16}$	$1\frac{15}{16}$	$1\frac{15}{16}$	$1\frac{11}{16}$
Number of hangers	9 or 10	10	11	12	12	13	14	14
Ave. resultant load per hanger†, Fig. 2	790	645	474	417	375	215	180	153
Ave. resultant load per hanger†, Fig. 1	465	435	410	350	375	215	180	153
Motor pulley (paper) size, in.	13D x 12F	12D x 10F	12D x 10F	10½D x 10F	10½D x 10F	.....	.....	.....
Groupshaft driven pulley size, in.	56D x 12F	45D x 10F	34D x 10F	36D x 10F	30D x 10F	.....	.....	.....
Groupshaft driver pulleys (8) size, in., Fig. 1	48D x 6F	32D x 6F	24D x 6F	19D x 6F	17D x 6F	14D x 6F	12D x 6F	12D x 5F
Groupshaft driver pulleys (8) size, in., Fig. 2	18D x 12F	17D x 10F	16D x 9F	15D x 8F	14D x 8F	14D x 6F	12D x 6F	12D x 5F
Countershaft driven pulleys (8) size, in., Fig. 1	24D x 6F	24D x 6F	24D x 6F	24D x 6F	24D x 6F	24D x 6F	24D x 6F	24D x 5F
Countershaft driven pulleys (8) size, in., Fig. 2	10D x 12F	14D x 10F	16D x 9F	18D x 8F	20D x 8F	24D x 6F	24D x 6F	24D x 5F
Motor belt (double) width and length	12" x 32'	10" x 30'	9" x 29'	9" x 28'	9" x 27'	.....	.....	.....
Countershaft belts width and length, Fig. 1	6" x 29'	6" x 27'	6"	6"	6"	6"	6"	5"
Countershaft belts width and length, Fig. 2	12" x 26'	10" x 26'	9" x 26'	8" x 27'	8" x 29'	7" x 30'	6" x 30'	5" x 30'
Countershaft belts, speed f.p.m., Fig. 1	2,500	2,500	2,500	2,500	2,500	2,500	2,680	3,600
Countershaft belts, speed f.p.m., Fig. 2	950	1,350	1,700	2,000	2,220	2,500	2,680	3,600
Countershaft to machine pulleys, Fig. 1	24D x 8F	24D x 8F	24D x 8F	24D x 8F	24D x 8F	24D x 8F	24D x 8F	18D x 8F
Countershaft to machine pulleys, Fig. 2	26D x 8F	26D x 8F	24D x 8F	24D x 8F	24D x 8F	24D x 8F	24D x 8F	18D x 8F

Face dimensions given for pulleys are nominal — actual belt width; pulley face is 5 per cent to 7 per cent wider.
*At motor drive.
†Assumptions on which performance summarized in Fig. 1 and Fig. 2 is based.

To answer the question, "Will the transmission losses in groups operated at higher groupshaft speeds be decidedly greater than under present practice?" let us compute in detail the group losses for a battery of machines with transmission designed for successively higher groupshaft speeds. Speeds of groupshafts ranging from 200 r.p.m. to 1,200 r.p.m. will be investigated. For the lower speeds the ordinary arrangement of a motor belted to a groupshaft will be assumed. For shaft speeds of 690 r.p.m. and above, the motor will be assumed to be connected directly to the shaft by means of a double flexible coupling.

At 600 r.p.m. both plans will be investigated.

Assume that the group consists of eight special-purpose grinders requiring a driven-pulley speed of 1,000 r.p.m. and a power input varying from 1 or 2 hp. to 16 hp. during an

For the 200-r.p.m. groupshaft, a 900-r.p.m. motor.

For the 300- and 400-r.p.m. groupshafts, a 1,200-r.p.m. motor.

For the 500- and 600-r.p.m. groupshafts, an 1,800-r.p.m. motor.

Groupshafts direct-connected to motors and operating at motor speeds of 570, 690, 850, and 1,140 r.p.m. will also be considered.

The selection of some elements of the transmission equipment, particularly the type of pulley and the speed of the countershaft belt, in such a manner as to give a fair comparison presents certain difficulties, because both affect the losses profoundly. For the high-speed drives, it is reasonable to suppose that an engineer would use steel pulleys having spokes designed to minimize fan effect and showing the lowest windage loss of any on the market. It was decided to use these pulleys on both the groupshafts and the countershafts. Cast-iron pulleys are more commonly used on countershafts; however, the windage losses of cast-iron pulleys exceed the corresponding losses of these particular steel pulleys by amounts varying from 70 per cent for pulleys one diameter wide to 800 per cent for pulleys that are narrow in comparison with their diameter.

must be selected largely to give practical pulley sizes and favorable ratios on the countershaft and machine belt drives. For the higher groupshaft speeds 2,500 ft. per minute worked out well. Here also it seemed reasonable that the same belt speed should be used on the lower-speed drives for a fair comparison. The comparative results shown in Fig. 1 were obtained on this basis.

It must be admitted that this procedure gives rather unusual countershaft drive proportions at the lower speeds. The pulleys on the groupshafts, driving to the countershafts, are 48 x 6 in. for the 200-r.p.m. groupshaft drives, and 32 x 6 in. for the 300-r.p.m. drive, with 24-in. diameter countershaft pulleys and 6-in. countershaft belts. In most plants wider belts running at lower speeds would be used at present on these drives. The resulting pulley and belting windage losses would be

lower, the bearing friction losses higher. A second comparison has been made in Fig. 2, based on the practice observed in older plants.

The countershafts, pulleys, and belts were chosen to give gradually increasing belt speeds from 950 f.p.m. for the 200-r.p.m. groupshaft drive to 2,500 f.p.m. for the 690- to 1,150-r.p.m. groupshafts. A comparison of the data in Figs. 1 and 2 shows that with the slower speed of the countershaft belts, the corresponding reduction in pulley windage greatly exceeds the increase in hanger bearing losses and results in a 10 per cent reduction in the losses of the 200-r.p.m. drive. This amounts to, 1 per cent of total group horsepower.

At higher groupshaft speeds the difference is less. Above 300 r.p.m. scarcely any difference exists. At 200 r.p.m. the arrangement summarized in Fig. 2 requires twice as wide countershaft belting and pulleys as the alternative in Fig. 1. As the groupshaft speed is increased, the difference becomes less.

Many other alternatives might have been considered; for example, cast-iron countershaft pulleys with the customary six oval spokes. These pulleys would scarcely affect the results shown in Fig. 2 for the lower speeds, but would increase the total group losses in Fig. 1 at all speeds and in Fig. 2 at the higher speeds very decidedly—as much as 30 per cent at 1,150 r.p.m., as can be seen by reference to the data on pulley windage losses given in a preceding article. At 850 r.p.m. this increase is much less marked, and below 570 r.p.m. groupshaft speed it is unimportant.

As to bearing losses, the most unfavorable assumption possible was made: that all belts, including the motor belts, pull in the same direction from the groupshaft, giving maximum bearing loads.

Several common combinations of bearing types were investigated. As the speed increased certain types were omitted from consideration. No claim is advanced that these omissions indicate the extreme speeds at which any particular type of bearing can be operated; they indicate merely the individual opinion of the author as to the speeds at which he would eliminate them from consideration for installation in large numbers in the type of service under discussion.

Comparison of Figs. 1 and 2 shows that group losses, particularly at high speeds, depend to a considerable extent upon the proportioning of the transmission equipment. With no change except in countershaft belt speed and corresponding pulley size, the losses are affected 10 per cent at the lower speeds. By merely shifting from low-windage-loss to medium-windage-loss pulleys the total losses at extreme group speeds may be increased 30 per cent. In this case the cheaper drive has the lower losses, but in the case of the alternative countershaft belt speeds mentioned, the more efficient drive costs decidedly more than the less efficient alternative. Thus, in an economic comparison the 10 per cent difference is much reduced, or, even reversed.

It may seem that the total losses shown are too conservative. The over-all losses from motor shaft to machine pulley for these groups range from 6 per cent to 10½ per cent of the motor output. For ordinary 50-hp. groups a loss of 14 to 16 per cent is more usual.

The reasons for this discrepancy are as follows:

1. There are relatively few machines in the group. Ordinarily, groups contain more than eight machines, but in this case eight machines result in a 50-hp. group. Larger motors were considered too unwieldy to change quickly in case of breakdown. This condition does not affect the relative losses in an important degree. If the number of machines were tripled, the losses of the group would be increased, but the relative showing of high speed versus low speed would not be greatly changed. It would not be affected at all for the higher-speed drives having motors direct-connected to the groupshafts.

Had there been 24 machines instead of 8 in the group, each taking one-third as much power, the machine and countershaft belts would be one-third as wide, all losses would be unchanged except the pulley-windage losses, which would be almost tripled, and the hanger bearing losses, which would be increased by the greater number of countershafts, and increased further if a longer shaft were required. The net increase in loss would vary from 2 per cent of the total group load at 1,140 r.p.m. to 0.5 per cent at low speeds.

2. Use of a certain line of pulleys having the lowest windage losses of any widely used make is by no means universal, and their use on countershafts is still less common. This tends to give group losses somewhat lower than ordinarily found.

3. As explained in a preceding article, there are certain minor losses not included in the above analysis. Experience indicates that these might be expected to amount to 1 or 2 per cent of the total group horsepower.

An effort was made to use conservative values for all losses. The countershaft and machine belts are ample for the peak loads encountered. Values of slip and creep used for the various belts were based on average working conditions, with some belts about ready to be taken up, some recently taken up, and some at intermediate tensions. Consideration was given to the fact that the machine belts are nearly vertical. Creep and slip losses on the countershaft and machine belts were estimated during

TABLE II — AVERAGE EFFICIENCIES OF 50-HP. THREE-PHASE, 60-CYCLE, 440-VOLT MOTORS

	Per Cent Full Load		
Motor Speed	100	75	50
Nominal 1,800: approx. full load, 1,730	90	90	88½
Nominal 1,200: approx. full load, 1,140	90	90¼	89
Nominal 900: approx. full load, 850	89½	90	89¼
Nominal 720: approx. full load, 690	89¼	90	89
Nominal 600: approx. full load, 570	88½	89	88

TABLE III — AVERAGE EFFICIENCIES OF 10-HP. THREE-PHASE, 60-CYCLE, 440-VOLT MOTORS

	Per Cent Full Load		
Motor Speed	100	75	50
Nominal 1,800: approx. full load 1,730	88	89	88
Nominal 1,200: approx. full load, 1,140	88½	89	88½
Nominal 900: approx. full load, 850	87½	88	86
Nominal 720: approx. full load, 690	86½	86½	85
Nominal 600: approx. full load, 570	84	83½	81

the heaviest part of the cycle. A speed counter would show a lower per cent slip because it would average in the speed during the light-load portions of the cycle.

It would appear from the preceding that the losses to be expected from high-speed groupshafts are not much in excess of the losses from shafts operated at the present usual speeds, at least when the driven machines are operated at rather high speeds. At medium speeds the losses may be less than for present practice.

Elimination of the most troublesome belt in the group, the motor belt, would favor groupshaft speeds of 690 and 850 r.p.m., when reasonably applicable, as well as 1,140 r.p.m. when machine speeds will permit.

Apparently unimportant matters, such as the selection of countershaft belt speeds or types of pulleys, may make far more difference in the total group losses than wide variations in groupshaft speed.

Type of bearing selected has an effect on the total losses which is by no means negligible, but it is not so important as was generally believed twenty years ago and is widely believed even now.

The proportion of the total group losses comprised in pulley and belt windage, and the savings possible by the use of pulleys having a low fan effect are more than has been generally realized. For pulleys running at a rim speed decidedly higher than 2,500 f.p.m. these factors are even more marked than in the comparisons made in this article.

These two comparisons on a certain group drive cannot be accepted as indicating the relative losses of any and all groups when driven at the speeds considered. Anyone interested can make comparative estimates for his own conditions by means of data given in preceding articles.

In order that readers may compare the transmission equipment proportioned for the same drive at various groupshaft speeds, Table I has been included. In it are tabulated the sizes of transmission elements on which Fig. 1 is based. It is evident that considerable saving in cost of mechanical transmission equipment is possible in groups to which the higher speeds are applicable. For example, at 1,140 r.p.m. there is only one-third the weight of shafting as at 200 r.p.m., no greater cost of hangers and hanger bearings (the smaller size offsets the greater number), half the belting cost as compared with 200-r.p.m. drives as ordinarily laid out, and narrower but larger pulleys. For direct-connected groups at 570 and 690 r.p.m. these savings will be less and will be largely offset by the additional cost of low-speed motors.

The question may arise as to whether the variation in efficiency of motors of different speeds will greatly affect the over-all losses of the group.

For 50-hp. motors, the size in question, there is little difference. Table II shows the average efficiencies in per cent of several types of motors made by three prominent manufacturers. For drives requiring much smaller motors the efficiencies of the lower-speed motors do not hold up so well. Table III shows a comparison for 10-hp. motors.

The differences in power factor of the low-speed motors, particularly at fractional loads, are more marked. This consideration will limit the conditions under which an economic comparison will favor a direct-connected as compared with a belted motor for 570-r.p.m. groupshafts, to those cases where trouble may be expected with the motor drive belt, or where space is not available. Above 600 r.p.m. the direct-connected drive usually works out cheaper in total annual cost, considering both losses and fixed charges.

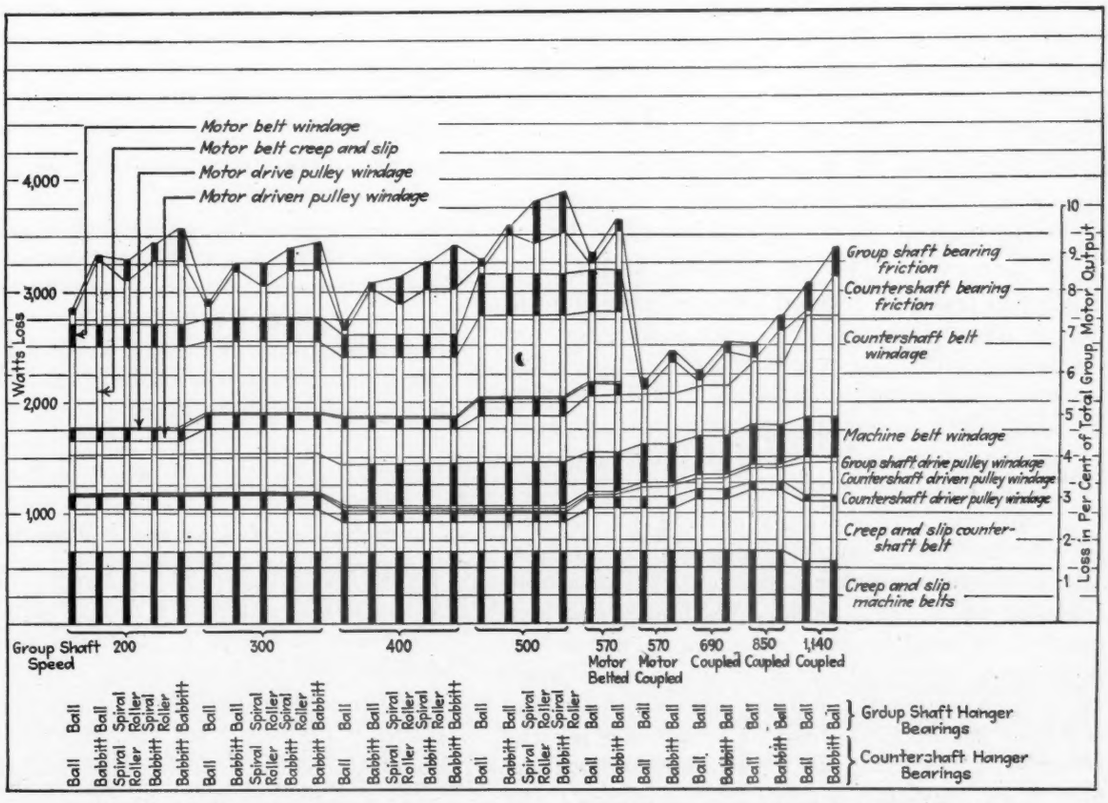


Fig. 2—Analysis of group drive transmission losses, using countershaft belt running at 950 f.p.m. with a groupshaft speed of 200 r.p.m., the belt speed increasing as the groupshaft speeds increase. The data in this chart are interpreted as explained for Fig. 1.

MAINTENANCE ENGINEERING

L. C. MORROW, Editor

JANUARY, 1932

Hope Springs Anew for 1932

FOLLOWING on the heels of budgets and inventories, early January affords an appropriate opportunity for reflection and planning. A comparison of the trend of business thought prevailing at the outset of each of the last two years with that of the present time will confirm the soundness of our present position and fortify our confidence in 1932 as a year of improvement.

The consensus of opinion on January 1, 1930, was that the disabled cylinders of our business machine, which started to miss right after the stock market crash of 1929, soon would be repaired and the machine would continue at its former breath-taking speed. Because the majority of us still believed that we were in a new era in which depressions were impossible, the continuation of the unparalleled prosperity of the preceding three or four years was taken for granted. This line of reasoning was responsible for the wait-until-business-picks-up attitude, which later was to be disastrous to many manufacturers. Schedules and policies for 1930, therefore, were based largely on the hope that the past would return in the near future rather than on a thorough analysis of existing conditions.

By January 1, 1931, our business machine had developed leaky valves and loose pistons in addition to its missing cylinders. Its inefficiency and excessive maintenance cost were aggravating a bad situation. Although almost all business leaders had lost faith in the theory of perpetual prosperity, hope for a quick return of 1929 conditions still influenced their policies.

At this time, when we are passing depression's second milestone, many changes are evident. The obsolete business machine of 1929 has been replaced by a 1932 model. Although the new machine is smaller and lacks the luxurious appointments of its predecessor, it is much more efficient, is designed to suit present conditions, and is within our means. Instead of wishing for the return of 1929 prosperity, many business leaders now hope that such an orgy of indulgence and speculation with its depressing results never will return. In many quarters there is confidence that business at last has found the road leading to a more stable and permanent prosperity.

Seldom has industry had as good an opportunity to wipe its slate clean and make a fresh start, using advantageously the lessons acquired through the experience of former years.

■

Add to Illumination Assets by the Use of Soap, Water and Paint

RELATIVELY, industry is illumination-conscious. Some of the diehards, some of the thoughtless remain to be sold on the advantages accruing from the practice of working in plenty of light. But by and large the men of industry know that good light makes for better quality, greater precision, time saving, and slow wear on the human mechanism.

Usually the new convert to good lighting makes his hallelujah by installing efficient lighting equipment—or by providing plenty of windows. Then he is likely to backslide, by failing to wash bulbs, globes, and windows, and by allowing his light reflecting surfaces (walls and ceilings) to become dirty.

Soap, water, paint, and elbow grease are the physical signs when the backslider once again is treading the straight and narrow. It is unfair to modern equipment of any kind to give it dark and dirty surroundings—most of all is it unfair to the human mechanism. And darkness-producing items are costly. If they are not paid for in terms of lowered efficiency of man-power, they are paid for in higher wattage, or lower quality, or other tangible or intangible outgo.

It's a maintenance job, this matter of keeping the old foot-candles where they ought to be. And the procedure is simple: Start with modern lighting equipment, housed by suitably painted walls and ceilings, and then keep both equipment and surroundings clean. Soap, water, paint and elbow grease are the tools; all of them are inexpensive when measured in terms of results.

■

A Success Recipe and a Way to Apply It

FROM the pile of conflicting success recipes amassed by our outstanding men, emerges one the truth of which is conceded generally. The gist of it is that something more than the conscientious and intelligent discharge of assigned duties is necessary for real success—one must do constructive work on his own initiative.

Few positions offer as many opportunities to apply such a recipe advantageously as the job of the maintenance engineer because his entire plant

is a fertile field for the initiation of projects to cut costs or to increase production. Many maintenance engineers have the intention and ambition to follow such a course but never get to it because they cannot seem to free themselves from the time requirements of their routine duties. Such engineers should take immediate steps to release a part of their time for original, constructive work.

The problem can be solved either by delegating part of the routine to an assistant or by discovering faster methods of performing it. Keeping constantly abreast of routine work not only shows a man's employers that he is on top of his job but, more important, it relieves his mind of the worry of unfinished, delinquent work and leaves it fresh and eager for the other kind of job.

■

What of Depreciation Reserves?

IN CONNECTION with industrial depression the matter of handling equipment depreciation in a scientific manner rather than as dictated by accounting expediency has been rather widely discussed.

A leading commentator sees one of the greatest evils of unbridled competition to reside in the procedure of many concerns in ignoring or manipulating accounting reserves in order to fool themselves and perhaps others into thinking that they are making a profit.

He feels that the matter of depreciation, which more than any other single item is subject to personal opinion, is abused most of all. That many companies practically ignore depreciation makes price competition with them extremely difficult for concerns that provide actual depreciation reserves. Although disregard of depreciation may lead to failure, the neglectful firms exert an injurious influence upon their industries as a whole while they are in business. When one such firm fails another no wiser springs up to take its place.

Ideally, physical depreciation should be contemplated in the light of actuarial data. In the interests of net profit and stability, plants should go as far as they can in setting up life expectancy tables for their various kinds of equipment.

But uncontrollable variables, such as obsolescence and increasing efficiency in design, make the calculation of expectancy very difficult. It is likely, then, that most conclusions as to probable physical life are reached by guess work based on experience with similar equipment.

Edwin B. Kurtz, in his book "Life Expectancy of Physical Property," proposes that plant surveys be made yearly or half yearly over a period of three or four years, and that equipment be listed according to age. There would then be available a record of retirements by age, arrived at within a relatively short time. Certainly such a record, even though leaving much of definiteness to be desired, would be of great value in the determination to purchase and the selection of equipment.

Maintenance engineers are concerned in depreciation and replacement—in the financial side as well as the physical. They are in duty bound to raise their voices in favor of actual monetary reserves for maintenance and replacement. They cannot hope actually to persuade unless they can present convincing actuarial data.

■

Volume Ninety

WITH this issue we begin Volume 90 of *Maintenance Engineering,* a consolidation of several publications. *Electrical Review,* begun in 1882 as the *Review of the Telephone and Telegraph,* with George Worthington as editor, was the founder paper. It absorbed *Western Electrician* in 1908, *Electrocraft* in 1912, and *Electrical Engineering* in 1918.

The McGraw-Hill Publishing Company purchased *Electrical Review* in 1922 and changed the name, first to *Electrical Review and Industrial Engineer,* later to *Industrial Engineer,* and subsequently to *Industrial Engineering.* D. H. Braymer became editor in 1922 and was succeeded in 1926 by G. A. Van Brunt, now associate editor. In December, 1927, *Industry Illustrated* was consolidated with *Industrial Engineering.* The present editor took charge in November, 1928. *Maintenance Engineering* became the name of the publication with the April, 1931 issue.

The staff of *Maintenance Engineering* consists of: L. C. Morrow, editor; G. A. Van Brunt, associate editor; E. P. Sweeney and T. A. Bissell, assistant editors; Carl Heyel, editorial assistant; and H. P. Dutton (Chicago), western editorial representative.

M. E. INDEX AVAILABLE

UPON request a copy of the index of the editorial contents of Maintenance Engineering for 1931 will be sent free to any subscriber.

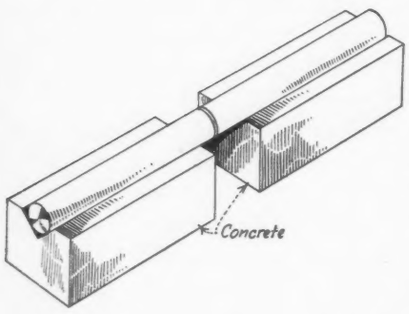
Although copies of the index will not be available until about February 1, we shall appreciate receiving requests as far in advance of that date as possible.

Around the works . . .

Readers are invited to submit descriptions of practical methods devised to meet specific operating conditions. The items may refer to details of installation, inspection and testing for maintenance, wiring, repair, and replacement

Concrete V-Blocks Align Material for Welding

ON BUTT-WELDING jobs it often is found difficult to hold the material to be joined in proper alignment. This trouble may be overcome easily by using two large V-blocks made of concrete to hold the material in place. It does not require any great skill to make up a couple of such blocks, and



they always will be found handy for welding pipe, shafting, rods, or square members. The manner of aligning the blocks themselves, to begin with, is simplicity itself. Keep a heavy piece of shafting, long enough to reach across the full length of both blocks, at hand. By using this shafting the blocks will align themselves almost automatically.

Peoria, Ill. JOHN E. HYLER.

■

Improvised Manual Control Facilitates Setting-Up Work

SOME time ago I was confronted with the task of keeping a machine in operation under difficulties, and my solution of the trouble may be of benefit to others.

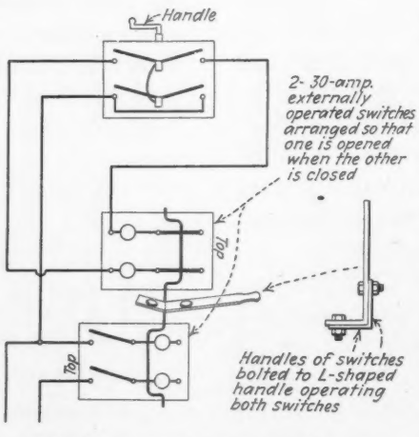
A large planer was equipped with an automatic control panel and a pendant switch so that the table could be operated manually when setting up work. When the knob of this pendant switch was turned to the left, the table moved in the direction of the cutting stroke and, when it was turned to the right, the table moved in the direction of the return stroke. After work was set up, a pull of the knob caused the machine to operate automatically.

A great deal of trouble, delay, and expense was caused by short circuits and grounds in the pendant switch even though it was well constructed. Possibly the job of handling direct current at 230 volts for a 35-hp. motor was too much for the switch because this load was in excess of the rating of the switch. A change was made by substituting a double-pole, double-throw, unfused, inclosed switch for the pendant switch as shown in the sketch. This switch was mounted so that the operator could throw it to the right or left while watching his helper set up the work.

At a convenient place on the planer two ordinary double-pole inclosed switches were mounted to operate from a common handle so that, when the work was set up, operation of this handle cut out the manual control and cut in the automatic control. The common handle, an iron strap bent 90 deg., was bolted to the handles of the two 30-amp. switches as shown. The arrangement of switches and the handle so that one switch is being closed while the other is being opened is indicated in the sketch.

A single-pole, double-throw switch could have been used in place of the double-throw, eliminating the jumper, but this equipment happened to be on hand. The entire installation is rugged and simple and will stand a lot of abuse without giving trouble. The 30-amp. switch that disconnects the upper contacts when opened was used to prevent trouble in case someone accidentally closed the double-pole, double-throw switch when the automatic portion of the panel was in service.

CHAS. A. PETERSON.
Mishawaka, Ind.

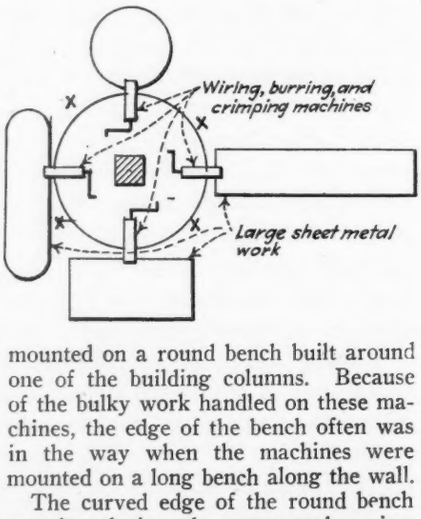

Handle
2- 30-amp. externally operated switches arranged so that one is opened when the other is closed
Bot.
Top
Handles of switches bolted to L-shaped handle operating both switches

Switching arrangement used to provide manual and automatic control for a planer. The upper switch provides manual control, the lower switches, mechanically connected, cut in on automatic operation by breaking the circuit to the upper switch.

■

Circular Work Benches Expedite Work in Tin Shop

IN THE tin shop of the maintenance department of a large manufacturer of breakfast food all of the wiring, burring, and crimping machines are



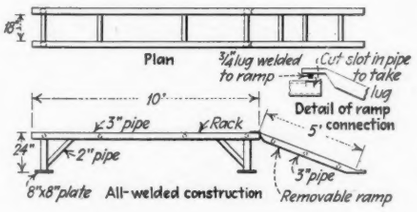
mounted on a round bench built around one of the building columns. Because of the bulky work handled on these machines, the edge of the bench often was in the way when the machines were mounted on a long bench along the wall.

The curved edge of the round bench permits placing the cans, tanks, pipe, or other large work up to the machines with little interference with the edge of the bench. Also, it is only a step around the periphery of the bench from one machine to the next. It has been found that long pieces of sheet metal work can be handled more easily than at a rectangular bench along the wall. The four spots marked with an X on the sketch indicate how close to the machines the tinsmith can stand when operating the cranks. F. E. GOODING.
Chicago, Ill.

Barrel Rack and Removable Ramp

A BARREL rack and ramp can be made from pipe as shown in the accompanying sketch. The rack is made by welding two lengths of 3-in. pipe together with 2-in. cross members, which are spaced as shown. The longitudinal members are 18 in. apart. Legs of 3-in. pipe with bases of 8-in. square plate are welded at each end.

The ramp is made up of the same size pipe and is about 5 ft. long. The ends are flattened as shown. One end has two lugs, ¼ in. thick and ¾ in. square,



welded to it. In the end of the rack two slots are burned large enough to receive the lugs. When the rack is to be used, the lugs are slipped into the slots in both sides of the rack to prevent the ramp from sliding out of position.

M. C. COCKSHOTT.

Arcadia, Calif.

■

Repairing Soil Pipe Joints

LAYING a line of cast iron soil pipe generally is regarded as strictly a plumber's job. However, the man responsible for the maintenance of sanitary and drainage systems in manufacturing works and power plants usually is expected to oversee such jobs, even if he does not perform the actual labor himself.

In a recent instance an operating man undertook the repair of four leaking joints in a vertical connection of a soil pipe line leading from a boiler-blowoff tank to a street basin. The joints had been poured before the pipes and fittings were aligned properly. The result was that the thickness of lead varied from $\frac{1}{16}$ to ½ in. in each joint. The oakum that had been stuffed in each joint before the lead was poured had rotted away. Much of the lead had been carried away by the blowoff current in the pipe after it had been loosened by vibration. Furthermore, the hot water vapor that was passing

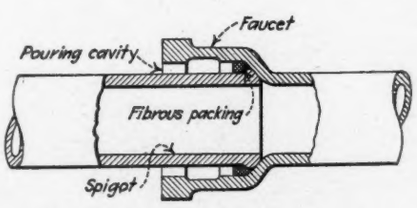


Fig. 1—Longitudinal section of a cast iron soil pipe coupling.

constantly through the pipe added to the discomfort of the undertaking.

The first task in repairing the joints was to pry the parts into alignment so that the spigot end of each joint entered the bell end centrally. Using a packing tool the engineer then rammed a wisp of flax tow, well daubed with white lead and twisted tightly, into the faucet of each joint, forcing it firmly into the bottom. This packing held the hot vapor in check. The flax tow previously described makes better packing than oakum because it makes an independent and permanent joint, whereas oakum depends upon its lead backing and eventually rots. Pouring the lead then was an easy matter because the faucet ends of the joints pointed upward.

To secure a serviceable lead-calked spigot-and-faucet joint in a horizontal line of soil pipe the first operation is to coat the inside of the faucet or bell and the beaded end of the spigot with a thin mixture of white lead and boiled linseed oil. This coating is followed by a liberal sprinkling of dry powdered white lead over the coated surfaces. Next, the ends are aligned as shown in Fig. 1, and a strand of twisted flax tow is calked in place in the manner described in the previous example. This packing will keep any water vapor in the pipe from leaking into the pouring cavity. To serve as a dam when the joint is poured an asbestos rope is wrapped around the entering pipe and slipped up against the mouth of the bell as shown in Fig. 2. The wooden clamp is used to hold the rope taut; it is attached so that a triangular opening or pouring gate will be left at the top of the joint. The joint is now ready for pouring.

The temperature to which the lead must be heated will be governed largely by attendant circumstances. For example, for outdoor work in cold weather when the heating is done some distance from the job the metal must be brought to fair red heat in order to flow properly. About ¾ lb. of soft pig lead must be used in each joint for each inch of pipe diameter. Care must be taken not to flood the cavity when pouring. It is essential that the molten stream be sufficiently restricted to permit the escape of all air in the joint.

After the pour has been made and the metal has had time to cool the asbestos rope should be removed, the protruding gate chipped off, and the lead calked in all the way around. The calking will eliminate any remaining air pockets. Do not concentrate too much of the calking in one place because such concentration may set up a stress that will crack the bell or force the lead out on the opposite side.

If a flux of dry powdered white lead is added to the molten lead and the mixture stirred thoroughly the metal will acquire a temper equal to that of common soft solder. The mixture is tougher than pure lead. When brought to a dull red heat the mixture will adhere readily to the white lead previously smeared on the joint surfaces of the pipes. When using such a mixture the ladle will have to be emptied while the metal is still molten because, if the metal is allowed to harden, it will stick to the ladle.

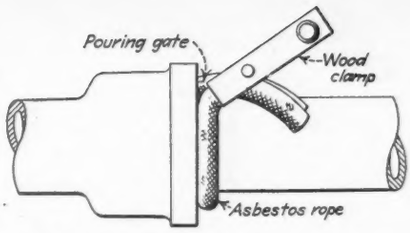


Fig. 2—Cast iron soil pipe joint ready for pouring.

Where many lengths of soil pipe are laid in a trench all leaded joints should be shored up with pieces of brick or stone to keep the joints from settling and to avoid bending stresses that might loosen the lead or fracture the pipe.

A. J. DIXON.

St. Louis, Mo.

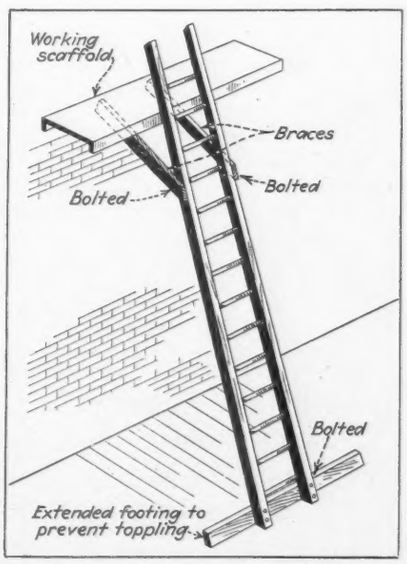
■

Combination Ladder-Scaffold Expedites Overhead Work

TO PROVIDE an inexpensive and serviceable means for reaching overhead lineshafting one shop foreman constructed the combination ladder-scaffold shown in the accompanying sketch.

The tool consists of a substantial ladder to which is secured a working platform about 6 ft. long. A horizontal footing is fastened to the base of the ladder as shown.

This portable scaffold can be moved easily about the shop when such jobs



A ladder can be converted into a portable scaffold by adding a platform and footing as shown.

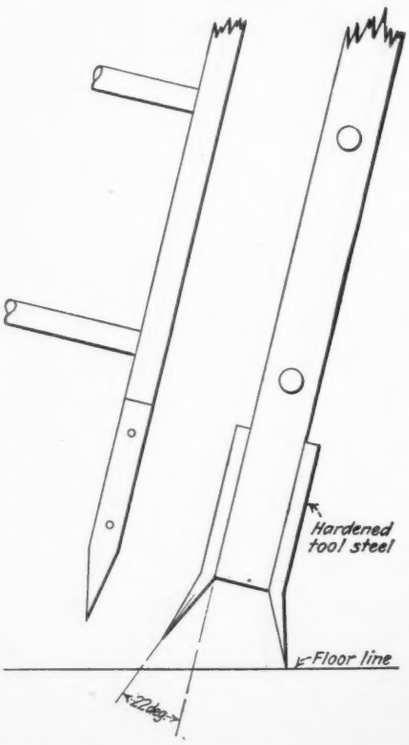
as adjustments, oiling, and pulley changes are to be performed on lineshafting. It also was found that the use of the scaffold makes window cleaning easier because it provides working space for a helper. This application alone justifies the construction of such a scaffold. G. A. LUERS.

Washington, D. C.

■

Safety Tips for Ladders

LADDER tips, made of steel straps provided with V-ends bent back 22 deg. as shown, make ladders resting on cement floors safe for any reasonable angle of tilt. The points always should



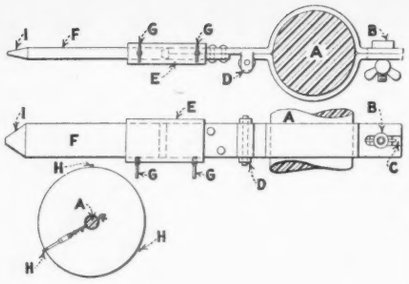
face the wall so that any movement of the ladder tends to make it "walk" against the wall rather than slip away from it. A tool-steel point properly hardened will hold its sharpness and maintain its effectiveness. Such tips are standard for ladders in the plant of the Motor Wheel Corporation, Lansing, Michigan. H. P. LEONARD.

Chicago, Ill.

■

Special Tool Simplifies the Shaft-Aligning Job

ONE OPERATION in aligning a lineshaft can be saved by use of a tool that I have designed. Ordinarily the lineshaft first must be aligned with regard to a vertical plane by means of a plumb bob, after which procedure a second operation must take place—leveling the shaft in a horizontal plane by applying a level to the top of the shaft. But, when my tool is used, the two operations are performed simultaneously.



In the sketch the shafting to be aligned is represented by A. The tool is clamped around the shafting by means of the hinge D, the slot C, and the combined bolt and wingnut B. The point of the tool I is provided with a telescopic adjustment consisting of the sleeve E and the two thumb-screws G. Any required length of the tool within its range thus can be obtained.

When ready to align, an equilateral triangle made of wood is secured at each end of the shaft. Each triangle is provided with three nails driven in with accuracy at the points corresponding to the corners of the same equilateral triangle. One of the nails is located exactly over the top of the shaft, and all three points are placed as nearly equidistant from the shaft as possible. After the triangles have been secured accurately in position, a line is strung between each of the three pairs of corresponding nails on the triangles. The tool now is made fast to the shaft near one end and the shaft is revolved slowly by hand. By adjusting the length of the tool and the position of the shaft in the hangers, a point can be reached where the extreme point of the tool I will just touch all three of the cords at H. The tool is then removed from the shaft and mounted similarly at the other end of the shaft where the same process is repeated. After the same operation has been repeated at intervals along the entire length of the shaft and adjustments made, the shafting is in alignment.

Peoria, Ill. JOHN E. HYLER.

■ ■

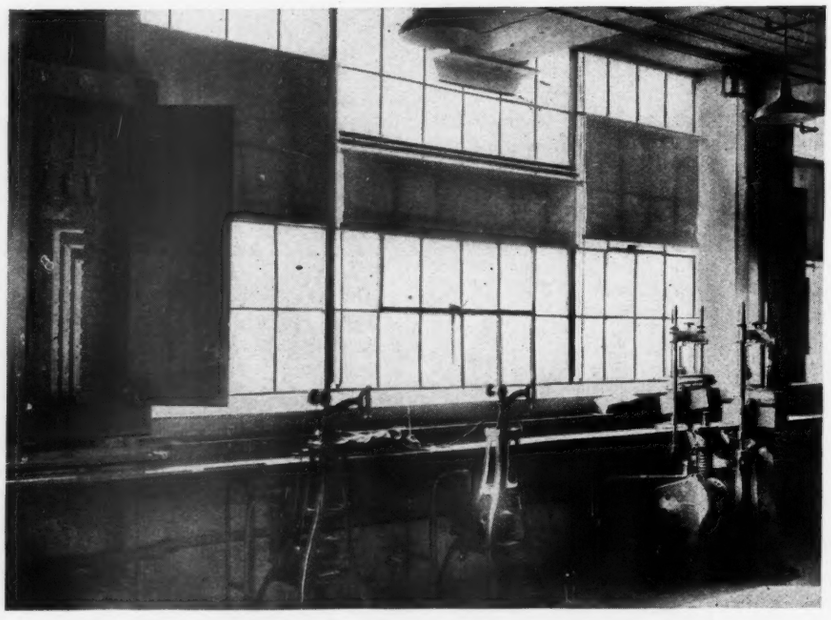
Metered Power Eliminates Guesswork

BECAUSE it is imperative that each foreman know what his power costs are so that he may determine accurately the cost of operation, electric power for each department in our plant is metered at the distribution panels which supply the electricity for lighting and power. The accompanying illustration shows two feeder panels located in this shoe factory. The panel on the left controls the power distribution for one department. A meter located above the steel housing records the power consumed in this department. The panel on the right controls the lighting circuits which are metered in the same manner.

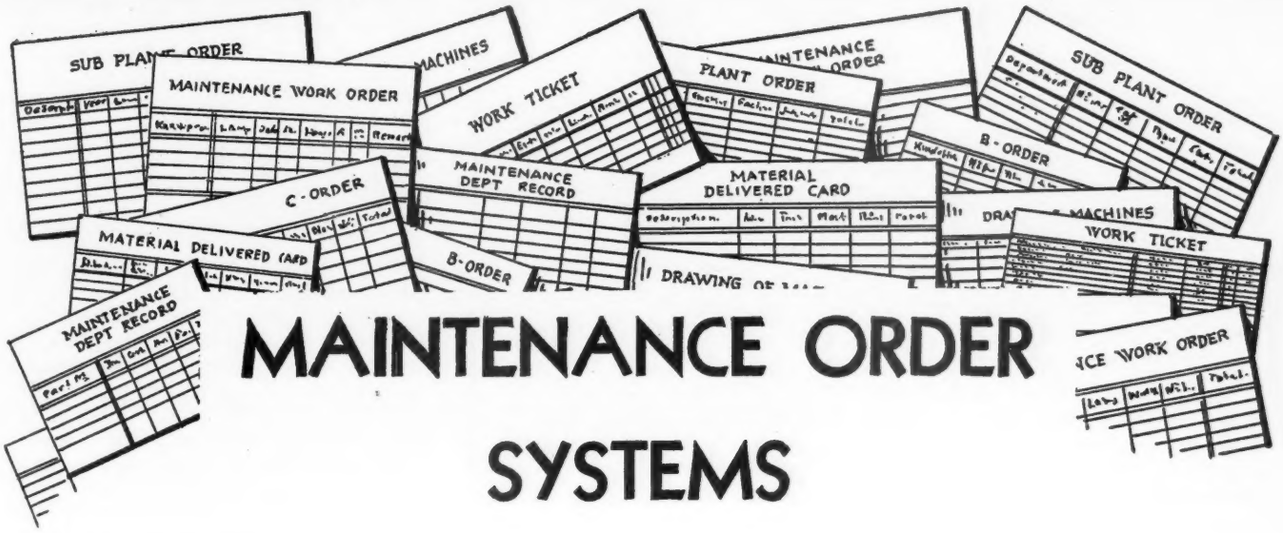
These installations are typical of this factory and give us an opportunity each month to accurately charge out the power consumed in each department. Power charges are broken down into departmental charges covering approximately forty separate units. This system of metering has eliminated all guesswork in allocating power charges.

K. D. HAMILTON.

Mechanical Department
Geo. E. Keith Company
Campello, Brockton, Mass.



Distribtion panels are equipped with integrating meters to obtain accurate power costs of departmental operations



MAINTENANCE ORDER SYSTEMS

Part II—Maintenance Control With One Form

G. I. ROSS

Chief Engineer, MacDonald Bros., Inc.
Boston, Mass.

■

Last month Mr. Ross pointed out the importance of the maintenance order routine. In this article the system used by a hardware plant of 250 employees is described. Though simple—only one form is used—the plan has proved adequate for a small organization

A TYPICAL form system for small plant maintenance is in use by a hardware manufacturing company employing about 250 people. In this plant the maintenance work order* is made in duplicate by the foreman of the department requesting the work. The original is forwarded to the Maintenance Supervisor and the carbon copy is retained by the foreman.

The Maintenance Supervisor determines who is to work upon the job and what material will be required. The material which is needed for the performance of the work is then withdrawn from stores on a material requisition and charged to the expense involved.

The maintenance work order is inscribed with the name or number of the man or men performing the work on the job and, upon completion of the work, with the elapsed time. It is then forwarded to the Cost Department for cost distribution purposes.**

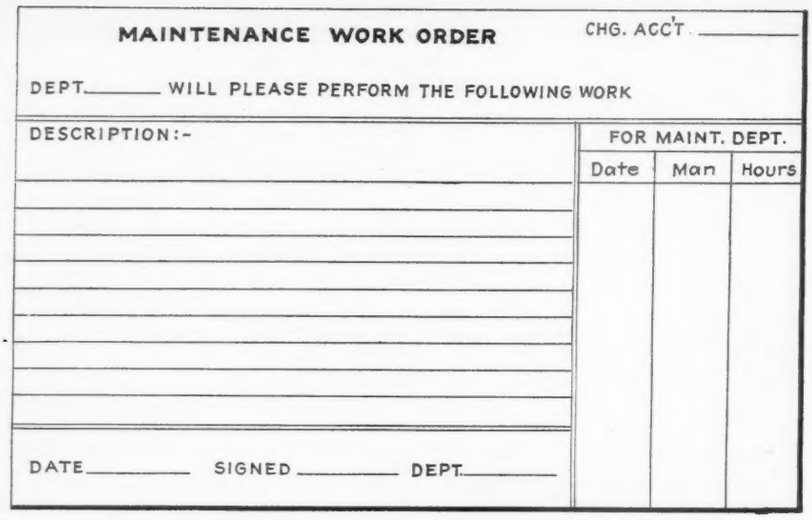
All maintenance employees are required to record the time of their arrival at and departure from the plant on a clock card. This card is examined daily by the timekeeper assigned to this work. The elapsed time is posted on this card and compared with the clock time. Any discrepancies are investigated because they may represent losses to the company.

For the requisitioning of maintenance supplies and materials, the requisition form provided for production materials is used. Care is exercised that charges for material are made to the proper accounts, for example the allocation of labor involved.

While this plan is not very elabo-

*If desired, this form may be viewed in the light of an order request. It would then require the approval of the Maintenance Supervisor before the start of work. The caption below the illustration of this form gives the actual size of the original. However, before the size of a form is decided upon the printer should be consulted as to the most economical dimensions. Standard sizes are those which will cut from stock without waste.

**In most small plants this form is simply filed in the office of the Maintenance Supervisor and serves no purpose in the allocating of costs or in the "tying in" of the job time with the clock-card time. This, of course, is faulty practice.



MAINTENANCE WORK ORDER CHG. ACC'T _____

DEPT._____ WILL PLEASE PERFORM THE FOLLOWING WORK

DESCRIPTION:-

FOR MAINT. DEPT.

Date	Man	Hours

DATE_____ SIGNED _____ DEPT._____

Fig. 1—Maintenance Work Order, original and duplicate. This maintenance work order is filled out and, upon completion of the job, forwarded to the Cost Department. Actual size, 8x5 inches.

rate, it will serve well in many small plants where close contact between management and operatives is easily maintained.

Another comparatively simple method will be discussed next month, when a metal working plant of 300 employees will be considered. In succeeding articles, the more involved systems in use in larger plants will be treated, where increased complexity of operation demands many forms.

■

BOOKS

Wages and the Road Ahead

By James D. Mooney. Longmans, Green and Company, 55 Fifth Ave., New York, N. Y. Cloth binding, 149 pages, 5½x8 inches. $2.

ADMITTING the soundness of the high wage theory, the author believes that, nevertheless, the present emergency justifies wage reductions—in fact makes them imperative. In brief, he proposes a "bargain day" provided by the wage earner (as well as the stockholder and the white collar worker) to lower the unit cost of production. Lower unit cost means lower cost to consumer, with more purchases made, consequently more production necessary.

Mr. Mooney states the objections that are and will be offered against wage reductions and then constructively refutes them. Especially appealing is his proposal that we wait no longer for some new industry to drop into our laps, but start in at once to rebuild America, providing for our 120,000,000 people homes that will be of standards hitherto unrealized, and yet within economical reach of home consumers.

If you have been feeling that wages and salaries should go down along with the cost of living and returns to stockholders, you will find convincing support in "Wages and the Road Ahead." If you think that you are definitely opposed to wage and salary reductions, you are in danger of having your mind changed if you read this book.

And the reading itself is a pleasure—no wading over your head—just plain sailing such as the man not versed in the technicalities of economics likes.

■

Valve Standards

CENTER-TO-FACE dimensions for ferrous flanged valves developed and approved by the Manufacturers Standardization Society of the valve and fittings industry as standard practice have been tentatively recommended for adoption as an American standard by Subcommittee No. 5 of the Sectional Committee on the Standardization of Pipe Flanges and Fittings. This proposal sets forth the center-to-face dimensions of cast iron and steel flanged valves of the wedge, gate, globe, and angle types over a considerable range of sizes and pressures. When adopted this standard should facilitate considerably the replacement of valves in existing piping systems.

This tentative proposal is now being distributed to a number of interested firms and individuals for criticism and comment and after receipt of these comments the Subcommittee will formulate a definite recommendation for submittal to the Sectional Committee.

■

Occupational Disease Legislation

THE REPORT of the Committee on Standard Practices in the Problem of Compensation of Occupational Disease of the American Public Health Association is presented in this 124-page booklet in a more complete and authoritative form than when it first was submitted in 1929. Although a large part of the text is given to laws covering occupational diseases in the United States, the publication includes an outline of similar legislation enacted by practically every other country on the globe. Emphasis is placed on the basis of compensation and the arbitration of claims arising from occupational diseases.

The price is $1.50. Copies may be obtained from The American Public Health Association, 370 Seventh Ave., New York City.

■

Belt Drives with Cast Iron Pulleys and with Paper Pulleys

"BELT Drives with Cast Iron Pulleys and with Paper Pulleys," by C. A. Norman and G. N. Moffat, department of mechanical engineering, Ohio State University, has been published as Bulletin 62 of the University Engineering Experiment Station.

Investigation was made of the transmissive power of oak tanned leather belts and rubber belts on cast iron and paper pulleys to ascertain the transmissive power of these various combinations, particularly at small angles of contact.

The bulletin contains a description of the tests, photographs of the apparatus used, and 25 graphs presenting results. Copies may be obtained without charge by addressing the Director, Engineering Experiment Station, Ohio State University, Columbus, Ohio.

■

Plant building deterioration goes on all the time, and one of the most vulnerable spots is a window. In the February issue S. C. Hunter tells how to reduce maintenance on steel and wood sash.

QUESTIONS and ANSWERS

Using Flexible Couplings on Lineshafts

We have found it almost impossible to keep several of our lineshafts properly aligned. These shafts range from 50 to 100 ft. in length and are mounted in babbitt bearings. The building is of mill-type construction and widely varying loads on the floor above, over which we have no control, change the alignment almost from day to day. Equipping the lineshafts with self-aligning ball-bearing hangers and using flexible couplings, instead of the solid type now used, has been proposed. If any readers have tried this expedient, I wish they would let me know what results were obtained. **M.L.**

Chicago, Ill.

■

Why Won't This Motor Operate as a Generator?

Recently I bought a used d.c. motor, of about 1 hp., which did not have any name plate data, and I am at loss as to its exact rating. However, I connected it to 110 volts d.c. and it ran satisfactorily. It is a two-pole, compound-wound machine. The field poles are laminated. I wish to convert it into a generator for testing purposes. I tried various connections and directions for different speeds, but it simply won't generate, although I do get a very small deflection on a low-reading d.c. voltmeter. The armature tests O.K., and so do the field poles. The shunt winding consists of about 7,000 turns of No. 34 wire, and the series winding of 50 turns of No. 22. The coils test out O.K.

Indianapolis, Ind. **J. R. M.**

■

A Compound for Fastening Pigtails to Motor Brushes

Can any of your readers supply us with information as to the making of a compound for fastening pigtails in carbon brushes? **F. D. C.**

Courtdale, Pa.

Please submit answers promptly. We expect to publish no answers later than the second issue following the appearance of the question. Selection will be made on the basis of quality, but answers first received have the best chance of being used

■

High-Gloss versus Flat Paints

I should like to know whether paints that dry with a comparatively high gloss are more or less suitable than so-called flat paints for use on the walls and ceilings of industrial buildings. I have in mind such factors as light-reflecting ability, tendency for dust and dirt to adhere to the surface, ease of cleaning, and general durability. What conclusions have readers come to in this matter?

St. Louis, Mo. **E.O.E.**

ONE OF the most important functions of interior painting in industrial plants is to improve the amount of illumination at the work. Fundamentally a paint should be chosen which will have the best sustained ability to reflect light. To a large degree the color that is chosen should be a light tint because the near white tints reflect more light than the darker colors. For example, a very popular combination is a near white color on ceiling and upper walls initially reflecting from 85 to 90 per cent; a light tan or apple green color for walls, that reflects from 60 to 70 per cent, and a dark ivory or medium green treatment of lower walls, with a reflection value of 40 to 50 per cent.

It is a common fallacy to think that the more shiny the surface, the more light is being reflected therefrom. From a glossy surface the reflected light in general obeys the law of regular or specular reflection and we get images of the light sources or an uneven distribution of illumination. From a mat or non-glazed surface, the maximum light reflected is in a direction normal to the surface, regardless of the angle at which the light may strike that surface. Glazed surfaces usually tend towards glare and consequently the mat or eggshell finishes are preferable from the standpoint of eye comfort.

A second factor that must be studied carefully is the question of fading. However, this change usually does not lower the reflecting efficiency of the paint, whereas the gradual accumulation of dust will do so. Much data are available in the literature, particularly in the Illuminating Engineering Society Transactions, covering studies of paints and painted surfaces.

Many plants have found it profitable to establish methods of cleaning and of preserving non-glazed surfaces, finding the improved results justifiable from the standpoint of increased illumination. In some cases, a thorough washing of the ceiling and walls will increase both natural and artificial illumination by as much as 50 per cent. Various methods are familiar, one being to spray a large painted area with water before washing, in order to avoid streaky appearances that result if, for instance, a wet sponge is applied directly to a dry surface. Another process reported successful is to coat a freshly painted surface with a thin solution of colorless starch. After a period of a few months this starch is washed away with warm water, taking with it all the accumulated dirt, then a fresh coating of starch is applied.

SAMUEL G. HIBBEN.
Commercial Engineering Department
Westinghouse Lamp Company
Bloomfield, N. J.

I DO NOT know that anyone has a definite answer to this question. It seems to be a matter of choice. Under certain conditions flat finishes might be more acceptable than gloss paints. Generally speaking, finishes that dry with a flat surface do so because they have a less amount of what is termed binder in the vehicle, result-

ing in the particles of pigment coming to the surface of the film, allowing the comparatively small percentage of binder to remain beneath the film.

This results in a drier or harder surface finish than that usually obtained with a gloss product. For this reason particles of dust and dirt that collect on the flat finish are more easily removed. On the contrary, flat finishes as a general rule are harder to wash without showing streaks or smudges. At the same time, when gloss paints are washed there is a tendency to grind the particles of dust and dirt into the finish, resulting in a surface that is not quite as clean as expected.

The individual responsible for selecting a suitable finish for a certain surface is the one to decide this question.

ROY C. SHEELER
Assistant Manager
Prescription Paint Service
E. I. du Pont de Nemours & Company
Philadelphia, Pa.

IT HAS been my experience that gloss paints are much more preferable and durable than flat paints, especially from a maintenance standpoint, since E.O.E. has emphasized the fact that cleanliness and durability are outstanding factors.

Flat painted walls and ceilings which are to be washed at regular intervals are not satisfactory because dust and dirt adhere to the porous surface. Also, when cleaning agents such as soap and scouring powders are used it will be found that additional labor and expense are necessary, and it will also be found that after several washings the paint will wash off and a new coat becomes necessary.

When gloss paint is used the maintenance cost is lowered because the cleaning agent cost is materially reduced. This paint will not wash off easily, and will not require frequent washings.

In maintaining gloss painted walls and ceilings, dust is removed easily in most cases with a dry cloth. Where the walls or ceilings are high, a wall buffer or hair floor push broom may be used by fastening a dust cloth to the cleaning or sweeping side of the brush.

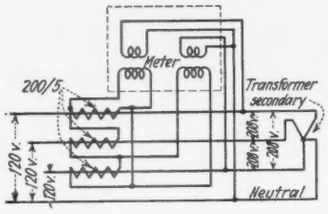
The cost of gloss paint will be slightly higher than flat paints, but this difference in cost will be offset in time by the reduced amount of maintenance necessary.

F. J. H. KRAUSE
Building Engineer
Southwestern Bell Telephone Company
Dallas, Texas.

■

Metering Three-Phase, Four-Wire System

The meter shown in the sketch is a two-element, 5-amp., 100-volt wattmeter connected to a three-phase, four-wire system. I wish that readers would tell me



(1) whether this meter will indicate correctly on unbalanced loads. (2) What multiplier should be used with this wattmeter.

H. B. W.
Seattle, Wash.

CONCERNING question (1) it is possible to obtain correct indication in the usual instances of application met in practice. A detailed series of tests conducted some years ago showed that for most conditions the results were practically as correct as for the method using a three-element meter, which is the exact method. The accuracy of the arrangement is affected by voltage unbalance rather than by current unbalance, but in the usual commercial circuit this is not serious. The method is used by large utilities for metering energy in watt-hour meters. (2) The constant for the arrangement shown is 80, assuming two-to-one potential transformers to be used, although they are not shown in the original diagram.

C. O. VON DANNENBERG
New York, N. Y.

How Take Down Sheet-Iron Smokestack?

It is necessary for us to remove a sheet-iron stack 36 in. in diameter and 90 ft. high, which we want to salvage for further use. We need information on the best method of procedure, and will appreciate it. J. E. K.
Newllano, La.

ONE METHOD of salvaging the stack in one piece, and in my opinion the best, would be to use two gin poles at least 60 ft. high with the headers about 10 ft. above the center of the stack. The poles should be supported on all sides by dead man guide lines. The stack should be tied to a line which will come through the header block and which will be snatch-blocked at the bottom to a dead man below. The next course will be to outline the check block near the base on which will be a snatch block within a radius of 60 ft.

J.E.K.'s first move should be to take the slack on the header block. After this, he should shear off his angle at the base and burn enough of the stack to release it. He can then carry off the base by means of the shaft and two small pulleys tied to the base of the stack and slack off on the center headers until the stack is in a horizontal position. Bringing the stack down by the above method he will always keep his heavy end on the small truck and at no time will the stack be out of control.

Should the stack be in a weak condition because of age, weather conditions, or work previously performed, I would advise him to remove the stack in sections on which he can use a single gin pole.

The size of the pole depends upon the size of the stack units. If the latter method is used it would be advisable to keep the gin pole supported by guide lines.

JOSEPH A. STONE.
Assistant Plant Engineer
Kelly Press Division
American Type Founders Company
Elizabeth, N. J.

VARIABLE voltage control, frequently referred to as "Ward Leonard control," was developed a considerable number of years ago, and has had wide application in elevator work. Essentially it involves control of motor speed by controlling the voltage of the generator supplying that motor.

Among its advantages are very accurate control of speed and simplicity of the control equipment required. These advantages have led to a rather wide adoption of this method of control in industrial work, and its use is increasing.

Obviously readers of Maintenance Engineering must keep up-to-date on this subject. The editors will provide the means in an article on variable voltage control in the February issue.

Fig. 1—Night view of machine shop. The good general illumination makes it unnecessary to equip a single machine with a special light.

17 Foot-Candle Illumination Without Local Lighting

W. A. COULTER

Sikorsky Aviation Corporation
Bridgeport, Conn.

We chose to depend entirely upon general illumination. Results justify our lighting system

THE MANUFACTURING department of the Sikorsky Aviation Corporation plant at Bridgeport, Connecticut, is contained in one large building, and all manufacturing activities are carried on under one roof. The company makes large airplanes of the amphibian type. With the exception of the finishing of wings, which is done in the "dope room," none of the processes of manufacture is isolated from the others.

Through the center of the building runs the assembly bay, to which the hulls, wings, and parts for final assembly are brought from either side. Under the general production scheme various processes which ordinarily might be concentrated at one location in the plant are carried on wherever the materials or parts requiring them are being handled.

The Sikorsky plant consists of the main manufacturing building, of 100,000 sq.ft., an engineering and development building, of 40,000 sq.ft., and a service building, of 12,000 sq.ft. All these buildings are fireproof, of structural steel and brick, and about 40 per cent of the wall areas are of glass with steel sash. All are one story high with the exception of the office buildings, which are two stories. The monitor system, alternating high and low bays, was used in constructing this plant. In the main manufacturing building the assembly bay, 80 ft. wide by 35 ft. high, is in the center, and on each side are three bays 30 ft. wide by 12 ft. high, and three bays 30 ft. wide by 20 ft. high.

This construction, together with the large amount of glass area, provides for the transmission of the maximum of daylight throughout the factory. In order to take advantage of the light, all inside walls and structural members are painted in aluminum.

On the west side of the building are located the machine shop, sheet-

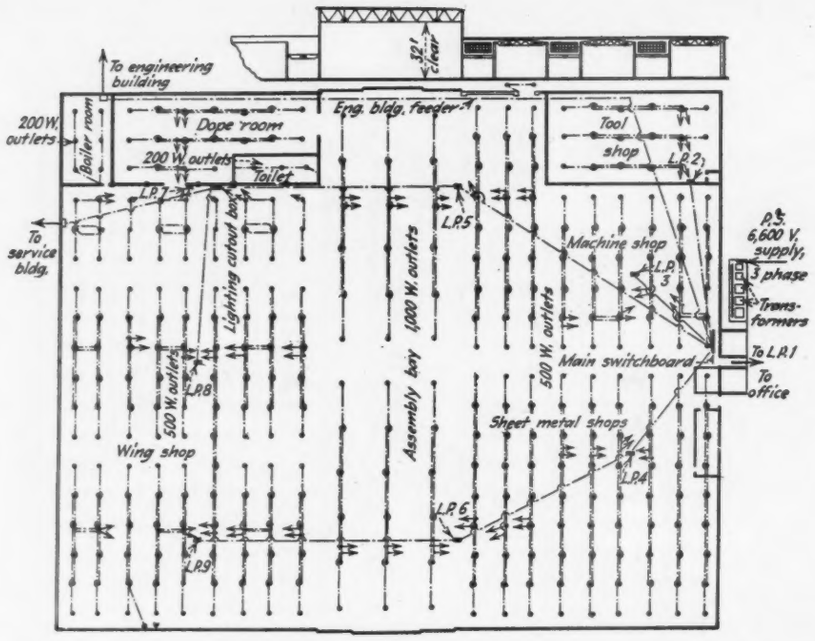


Fig. 2 — Lighting layout, main manufacturing building.

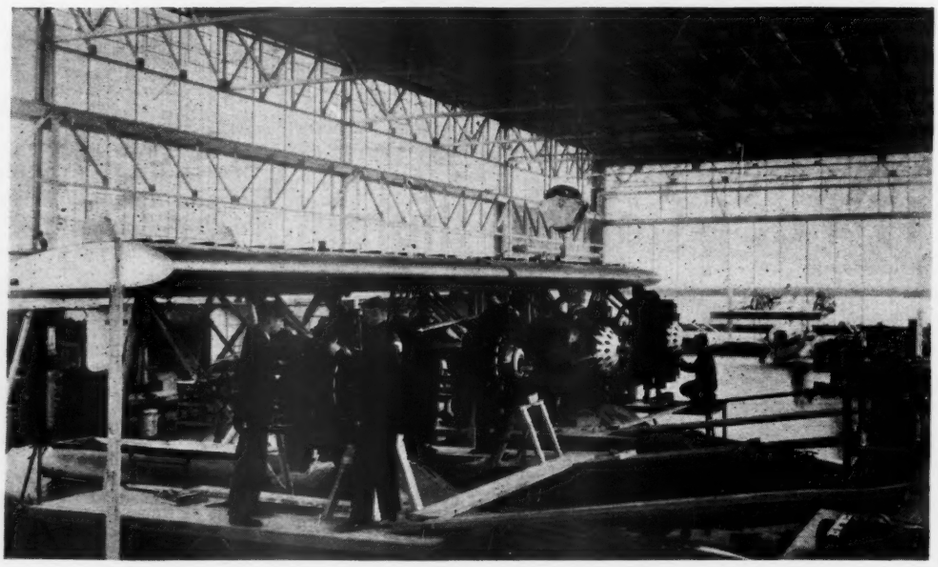


Fig. 3 — The assembly bay, where considerable work has to be performed under the wings which shut off the light directly from above. There is plenty of light for efficient work, and very little shadow.

switches, providing for complete isolation of the plant during emergencies or temporary construction periods. Two 150-kva. lighting transformers deliver three-wire, 220- and 110-volt, single-phase energy to the various sections of the plant. The two circuits overlap throughout, so that if one is interrupted no large areas will be in complete darkness. Each service is separately metered. Arrangements have been made so that larger transformers can be substituted in a few hours' time if necessary, should the plant growth require it. Lighting buses are designed for 1,000 amperes.

There are twelve lighting panels, with main fuses and the usual subfeeding from one panel to another. The panels are installed on columns at equidistant points. With 20 switches per panel, very good control of the lighting is obtained at any section of the factory. Full safety type tumbler switches were specified. The

metal shop, hull assembly, and stock rooms. The east side is devoted almost entirely to the manufacture of the wings and tail surfaces. The ribs and spars are built up of aluminum alloy metal, and are assembled, painted for protection against corrosion, covered with fabric, and finally doped and finished ready for assembly to the hull.

In this department, also, is given the anodic treatment, an electrolytic process of oxidizing aluminum alloy parts as a protection against corrosion. All parts made of aluminum alloy have to be given this treatment before they are painted.

The current for lighting and power is furnished by the United Illuminating Company, of Bridgeport, Conn., through a 600-kva. industrial substation on the premises. It was very desirable to eliminate any hazard to flying that might be caused by overhead lines. Such hazard was avoided by bringing a 6,600-volt, three-phase feeder underground from the power company's system into an outdoor substation containing a single high tension bus from which taps were made to the primaries of 300-kva. separate lighting and power transformer banks.

Between the cable pot head and the high tension bus are a main oil circuit breaker and set of disconnecting

service is controlled from two sections of the main switchboard in the manufacturing building. Separate feeders are not run to each panel. Some feeder lines serve several lighting panels in succession, and the size of the conductors is reduced at each panel. For example, starting from a 400-amp. fused switch on the main switchboard, a circuit consisting of three 500,000-circ.mil conductors is run in 3-in. conduit to lighting panel No. 1, where it passes through a 400-amp. cutout, fused for 250 amp., and continues with 250,000 circ.mil conductors in 2½-in. conduit to lighting panel No. 8. This arrangement requires less expenditure for the feed-

ers than does the use of separate feeders to each panel, where the conductors must be large enough to prevent excessive voltage drop over comparatively long distances. For accessibility all of the subfeed cutouts for these circuits are mounted directly above the lighting panels.

It was decided in the beginning to provide good general illumination and to dispense with local lighting. To achieve this end it was necessary to install large units. The increased load is more than justified by the very satisfactory results. For example, the average intensity of illumination is 17 foot-candles on a working plane 30 in. from the floor. The average wattage per sq.ft. is 1.65. In the machine shop it was unnecessary to equip a single machine with a special light for night work, although overtime has been the general case in the shop for over two years. In the assembly bay, where considerable work has to be performed under the wings which shut off the light directly from above, there is plenty of light for efficient work, and very little shadow.

Throughout the main factory building, with the exception of the high assembly bay and dope room, 500-watt units with RLM porcelain steel reflectors are installed close to the ceiling, on 18-ft. centers, and suspended on pipe stems. In the assembly bay, which is 35 ft. high, 1,000-watt, high-mounting fixtures are installed on 26-ft. centers. This spacing was decided upon in order to eliminate shadow as much as possible in this department.

In the dope room 1,000-watt units are installed on 16-ft. centers. This room is 120 ft. long, 50 ft. wide, and 22 ft. high. Dope is the liquid which is applied to the fabric of the wings to tauten it and to fill and seal the pores so as to leave a smooth surface for the finishing coats of lacquer, enamel, or pigmented dope. Dope is made on a base of cellulose nitrate, and the fumes from it are highly explosive. For this reason only vapor proof lighting units could be installed in this room. Vapor proof units are installed also in spray booths and in other rooms where painting is done and explosion hazards exist.

The lighting feeder for the engineering building consists of three 500,000-circ.mil, rubber insulated, double braided conductors in 3-in. conduit on wall and roof trusses, and extends from one of the 400-amp. switches on the lighting panel of the main switchboard to the point where it must cross to the engineering building. Here it is spliced to non-inductive cable of the same size, which is buried in a trench between the two buldings and is terminated in the lighting distribution panel of the dead-front safety switchboard in the engineering building. The lighting section of this switchboard is equipped with one 400-amp., fused, dead-front main switch, and from it branch eight 100-amp. circuits, two-wire, or three-wire with solid neutral, with 400-amp. main switches.

The main 120-ft. bay of the engineering building is lighted with 35 high-bay lighting units, with each unit controlled from two lighting panels. In the offices and drafting rooms an intensity of 20 foot-candles was specified. The fixtures installed are mostly of the industrial type, but they are fairly decorative.

The company utilizes an adjacent airport for the operation of its planes from land, but has a water landing area in the Housatonic river which flows behind the plant. Here it was necessary to construct a runway and ramp extending into the river about a thousand feet from the shore, in order

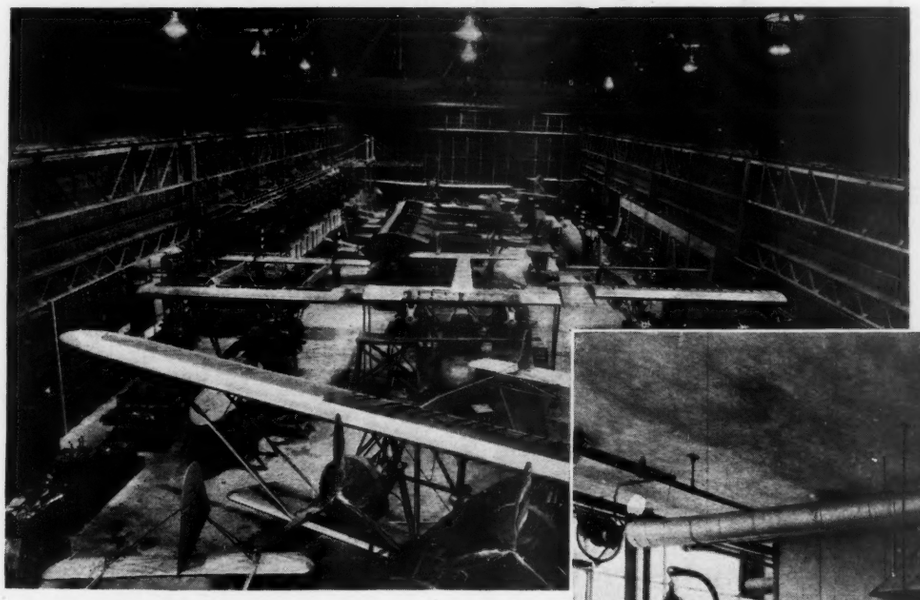
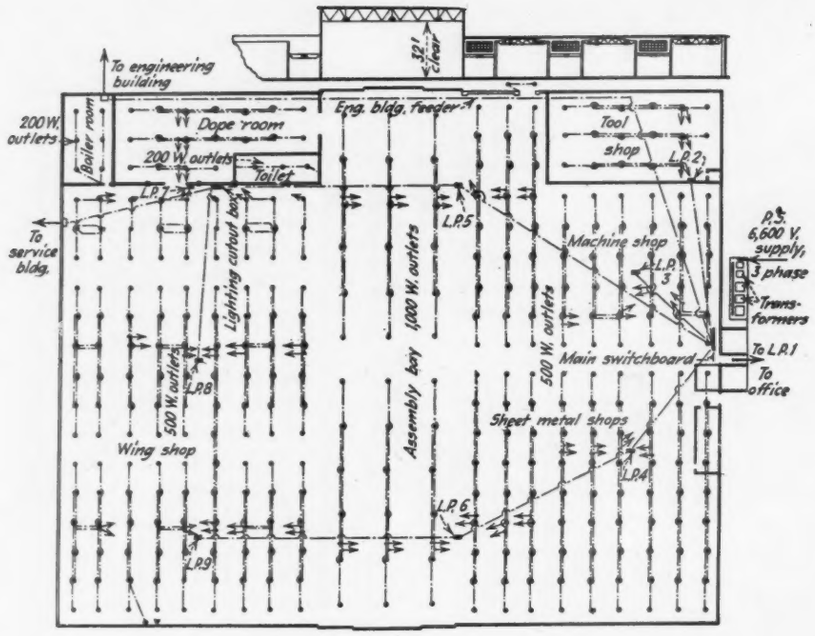


Fig. 4—Night view of assembly bay. In this room, 35 ft. high and 80 ft. wide, high-mounting, 1,000-watt fixtures, on 26-ft. centers, reduce shadow.

Fig. 5—View of cadmium plating and automatic painting room. Vapor proof units were installed in this and other rooms where painting is done.



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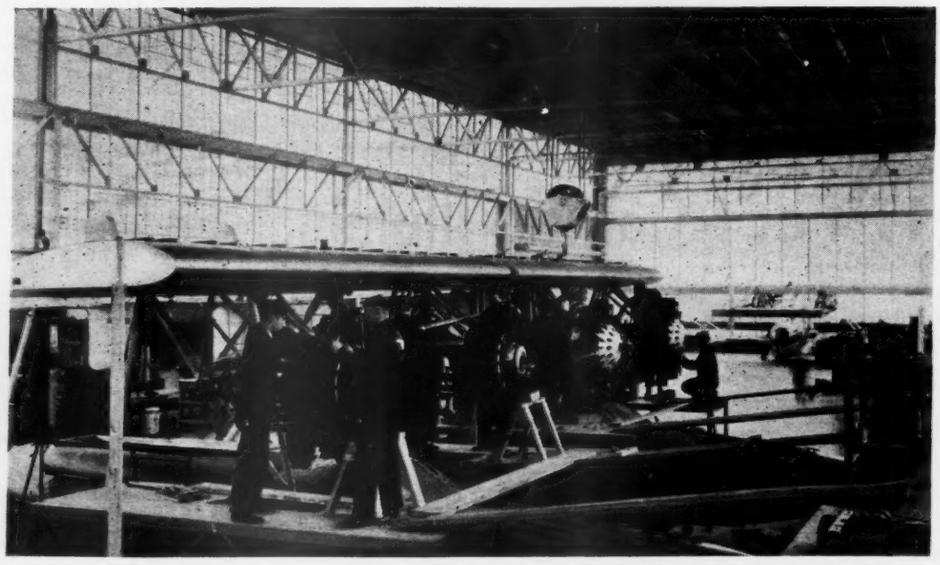

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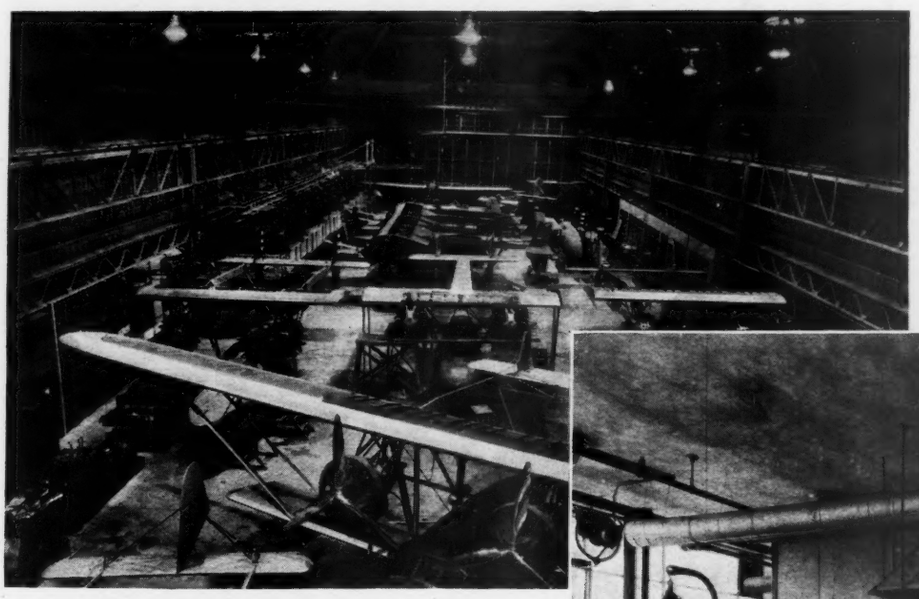

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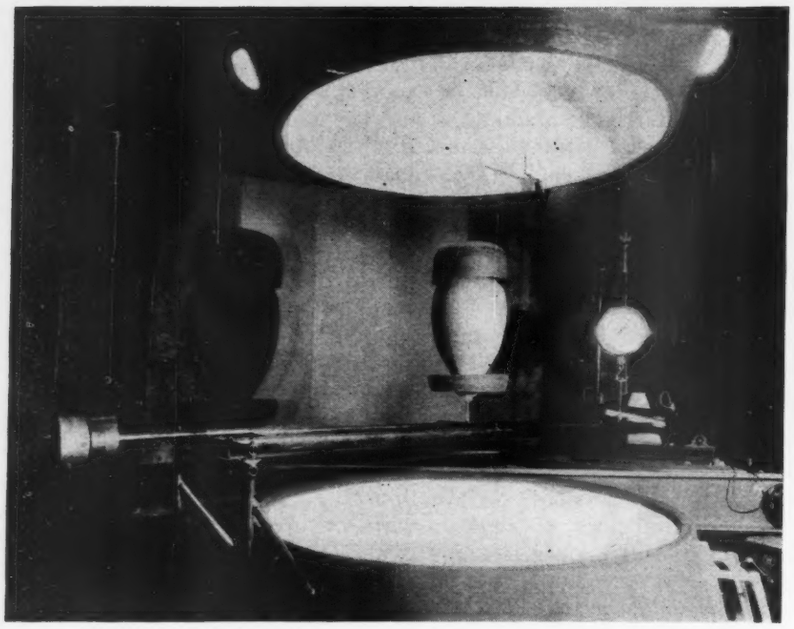


Fig. 6—Model being tested in the wind tunnel. The problem here was to light the space where the models are placed as well as the room where the operator works. Lights were placed in the ceiling of the tunnel, and additional fixtures were installed in the work room.

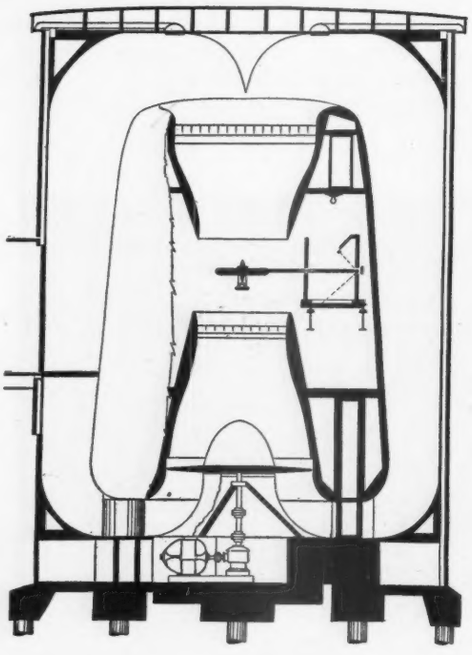


Fig. 7—Diagrammatic view of wind tunnel. Lights are mounted flush with the ceiling of the tunnel, so that no resistance is offered to the wind stream. Air ducts afford sufficient cooling.

to reach the deep water of the channel. Adjustable floodlights were installed at the ramp to furnish lighting for work on the planes after dark, and outlets were installed at various locations along the runway for the accommodation of portable lights as required. Outlets were installed on the outside of the building at convenient points around the yard, in case lighting should be required for night fueling of planes, or for other night work. Floodlights are mounted on buildings to provide light around large door openings.

Because of the proximity of the Bridgeport Airport, red obstruction lights were installed at the corners of all buildings, so that their location would be clear to planes landing at the airport at night. A weather vane for the benefit of aviators was installed over the wind tunnel building. It is lighted by a cluster of four lights. The tops of the lamps are red and the bottoms clear.

An interesting problem was encountered in the lighting of the wind tunnel. This device is an arrangement for testing the effect of the wind stream on various shapes and models of airplanes. At the Sikorsky plant the tunnel is built vertically, with the flow of air downward. The problem here was to light the space where the models are placed as well as the room where the operator works. Lights were placed in the ceiling of the tunnel (Fig. 7) and mounted flush so that no resistance would be offered to the wind stream. Plenty of insulation was provided and ducts leading to the outside air were made to afford sufficient cooling. Additional fixtures were installed on the ceiling of the working room of the tunnel. In making readings of the forces on the models a measuring beam of light is employed, and so it was also found desirable to provide an arrangement for dimming the lights of the room.

■

Handling Institute Formed

AT A MEETING in the Hotel Hollenden, Cleveland, Ohio, on Tuesday, December 8, approximately 70 executives representing over 50 individual manufacturing establishments organized the Materials Handling Institute. The general purpose of this new body is to develop a greater consciousness in industry of the importance of efficient and economical materials handling methods and to develop and promote a constructive program of research, standardization, and education.

Officers for the coming year are: president, Frank E. Moore, president, Mathews Conveyor Company, Ellwood City, Pa.; vice-president, Jervis B. Webb, president, J. B. Webb Company, Detroit; secretary, John A. Cronin, editor, *Materials Handling and Distribution,* New York City; treasurer, Henry W. Standart, president and treasurer, Northern Engineering Works, Detroit.

The board of governors consists of one representative of each group of manufacturers within the materials handling industry. Eleven different branches of the field are represented.

A letter from Matthew W. Potts, Secretary of the Materials Handling Division of the A.S.M.E. was read at the meeting, promising the cooperation of the division in any such institute or association that might be formed. In answer, the conference decided to hold its next meeting in Philadelphia during the National Materials Handling meeting which is being coordinated May 5th and 6th with the American Foundrymen's Association convention.

Safe Practices for Materials Storage
Oils—Acids—Dry Materials

(*Continued from the December issue*)

Bins for Dry Materials

Bins and hoppers are indispensable in many industries. The modern bin can be filled by means of a conveyor and emptied from the bottom by another conveyor. Very little personal attention to bins is required, which may be one reason for the low number of accidents which have occurred in them.

Permanent ladders or stairways, walkways, and platforms should be provided for all kinds of bins to make every part accessible. As with tanks, every point of the bin should be available for inspection to see that no failure has occurred. It is far cheaper in the end to provide bins with substantial walkways, stairways, or ladders when they are installed.

When working around bins that contain dry materials, men should be warned if there are explosive materials present. In bins for the storage of powdered coal or other materials where explosive dust can be produced, the use of an open light or the creation of a spark is hazardous.

The cause of most of the accidents around coal bins is the formation of coal arches which restrict the easy flow of coal. Various methods have been devised to break up the arched formation, probably the most common of which is to use long iron pike poles to stir the material. In some cases knotted ropes hanging the entire depth of the bin will break up successfully an arched condition. Although the use of a pike pole from the under side requires men to work more or less blindly, under no circumstances should workmen enter a bin, no matter what the depth of the material may be. A sudden slide may cover them completely and smother them. The elimination of such accidents requires proper education of workmen and enforcement of operating rules.

If a bin is open at the top, this opening should be protected by standard railings and toe-boards. If the opening is only a manhole, the manhole cover should be fastened securely to the top of the bin and, if possible, it should be made to close by gravity. This method of fastening can be used only if no pressure exists in the bin. It is preferable to locate manholes at one side of walkways where they are easily accessible. When men are not working in the bins, the manholes should be locked. In such cases the key should be in possession of the department foreman so that he can superintend the work personally and can be held directly responsible for the safety and welfare of his men.

The safety of some stock bins depends to a great extent upon their original design. One company had two fatalities due to slides of material during a year in the same bin because a man had to go into the bin to see that the spouts leading from it were being fed. The bin was rebuilt so that it had a V-shaped bottom, so that the spouts were fed continuously without personal attention.

Men should never be sent to work inside bins unless they are equipped with life belts and life lines. The ordinary window washer's belt, which is equipped with a pair of suspenders in addition to a large leather band around the waist, is preferred by many employees. Other employees prefer to have the life line fastened at the front of their belts. These life lines and belts should be inspected frequently. It is necessary to have an employee outside the bin, ready to render assistance to men working inside, should anything go wrong. No man should enter a bin unless his foreman has been notified previously, so that a close check can be kept on the safety of each employee. *(Conclusion.)*

Courtesy of National Safety Council

Actual cost of wasting plant services should be called to employees' attention. A sample poster, based upon conditions at a specific plant, is shown.

STOP LEAKS & WASTE!

DIAMETER OF OPENING	WATER		COMPRESSED AIR		STEAM	
	NO. OF GALLONS WASTED PER MONTH 40 LBS. PRESSURE	TOTAL COST OF WASTE PER MONTH AT 5 CENTS PER 1000 GALLONS	NO. OF CU. FEET OF AIR WASTED PER MONTH 100 LBS. PRESSURE	TOTAL COST OF WASTE PER MONTH AT 5 CENTS PER 1000 CUBIC FEET	NO. OF POUNDS WASTED PER MONTH 100 LBS. PRESSURE	TOTAL COST OF WASTE PER MONTH AT 40 CENTS PER 1000 POUNDS
1/2"	1,250,000	$62.50	17,798,400	$889.92	805,000	$332.00
3/8	692,400	34.62	9,979,200	498.96	460,000	184.00
1/4	307,700	15.39	4,449,600	222.48	203,000	81.20
1/8	76,900	3.85	1,114,560	55.73	50,500	20.20
1/16"	19,200	.96	278,640	13.73	12,750	5.10
1/32"	4,800	.24	69,552	3.48	3,175	1.27

NUMBER OF 200 WATT LIGHTS BURNING 10 HOURS PER DAY	LIGHTS	
	NUMBER OF K.W. HOURS WASTED PER MONTH	TOTAL COST OF WASTE PER MONTH AT 2 CENTS PER K.W.H.
10	480	$9.60
20	960	19.20
30	1460	28.80

HORSE POWER OF MOTOR	MOTORS	
	NUMBER OF K.W.H. WASTED PER MONTH AT 10 HOURS PER DAY	TOTAL COST OF WASTE PER MONTH AT 2 CENTS PER K.W.H.
5	375	$7.50
10	750	15.00
15	1,125	22.50

COMPRESSED AIR, STEAM, WATER & ELECTRICITY
COST MONEY

DON'T WASTE THEM

PACKARD MOTOR CAR CO.
CONSTRUCTION AND MAINTENANCE DIVISION

NOTE: MOTOR INPUT BASED ON 25 PERCENT LOAD FACTOR. AIR, WATER AND STEAM PER MONTH ARE COMPUTED ON BASIS OF 24 HOURS FOR 30 DAYS.

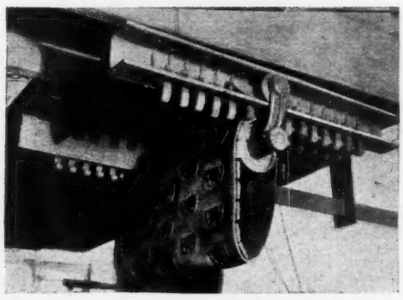
EQUIPMENT NEWS

Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these devices, which are designed to improve plant operation or reduce operating and maintenance costs

Stephens-Adamson Apron Gate

Ease of operation features the apron gate for horizontal bin bottoms developed by the Stephens-Adamson Manufacturing Company, Aurora, Ill. The gate opening is closed by the operation of a series of reinforced crossbars which are covered with a rubber apron. The apron is provided to prevent leakage. While the gate is being opened the bars are lifted, unhooked, and lowered one by one.

In operation a rack and pinion, driven by hand or chain wheel, moves an operating carriage back and forth to open and close the gate. While the gate is opening the carriage is pulled backward, causing the two lower rollers to lift the apron bars slightly and disengage the hooks. Cams hold the hooks until

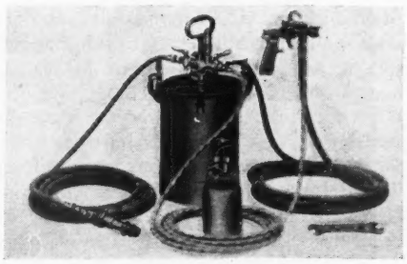


the rollers have passed and the apron has dropped. During closure of the gate the carriage is pushed forward, the cams open the hooks, the rollers lift the bars into place, and the hooks engage. The apron bars support the load in the bin above.

■

DeVilbiss Spray-Painting Outfits

Four general-purpose, spray-painting outfits, operated by the compressed air taken from an automobile engine cylinder, have been announced by The DeVilbiss Company, Toledo, Ohio. A special take-off device is screwed in place of one or two spark plugs of the automobile, truck, or tractor engine used to provide compressed air. The take-off unit is designed so that only fresh air from outside the engine is drawn into the cylinder for compression; therefore the engine cannot be injured by the prolonged use of these outfits. The outfits are known as Types VH-601, 602, 603, and 604 in order of size.



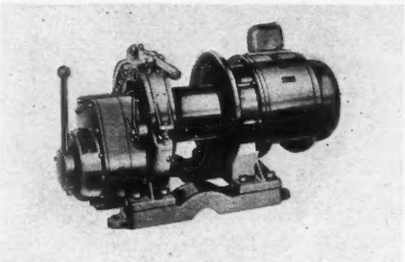
Type VH-601 consists essentially of a take-off and extension; a suction-feed spray gun with a glass cup; and an air hose with connections.

Type VH-604 operates from two cylinders of a six- or eight-cylinder engine and therefore produces a greater volume of air than the other outfits. It is equipped with two take-offs with extensions, one tee fitting, one pressure-feed spray gun with wrench, one 2-gal. pressure-feed paint tank, one feed cup, one length of air hose with connections, and one length of fluid hose and connections.

■

Ingersoll-Rand Portable Electric Hoists

Ingersoll-Rand Company, 11 Broadway, New York, N. Y., announces a line of portable, non-reversible, single-drum electric hoists designed for application in the mining, contracting, and industrial fields. The units are modeled after the line of "Utility" hoists, except that they use electric motors and friction clutches instead of air motors and jaw clutches. The hoists are suitable for all single cable work, such as hoisting timber, muck, tools, and pipe; hauling and spotting cars; and single-line scraping.

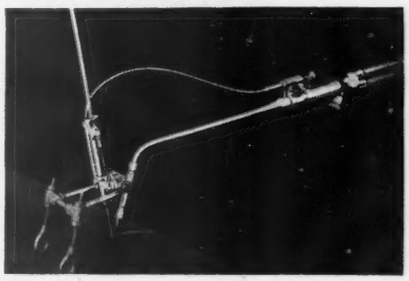


Each unit is provided with a self-energizing brake for stopping and holding the load and an automatic drum lock for added safety when handling a suspended load. Moving parts are protected by dust-proof construction. Bases are drilled and grooved either for column mounting or bolting to a flat surface. Either a.c. or d.c. motors can be furnished. Hoists are rated at 7½ and 10 hp. and are available for a variety of drum capacities, hoisting speeds, and lifting capacities.

■

Linde Welding Blowpipe

Type W-21 "Lindewelder" is the name of an oxy-acetylene welding blowpipe introduced by The Linde Air Products Company, 30 East 42nd St., New



York, N. Y. The instrument is a two-flame blowpipe with a rod holder that feeds the welding rod automatically by gravity. A rod-lifting device controlled by a trigger on the blowpipe handle permits the operator to raise or lower the welding rod as required. A carriage provided with two adjustable runners so supports the blowpipe during the welding operation that the operator can hold the blowpipe with one hand. Runners can be adjusted in length and angle to suit all types of work.

Two separate flames are utilized—one for preheating the welding rod and one for performing the actual welding operation. The upper or preheating flame is adjusted so that the inner cone impinges directly on the rod as it emerges from the lower end of the rod holder, preheating it nearly to the melting

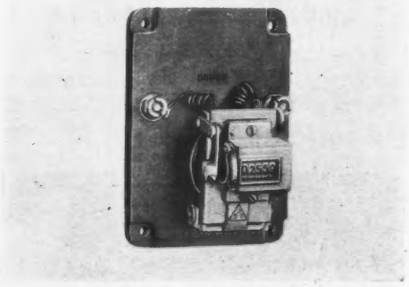
point. The lower or welding flame is directed so that it prepares the base metal for proper fusion with the weld metal and simultaneously melts the end of the preheated welding rod in the welding puddle.

Five sizes of welding tips, Nos. 9 to 13 inclusive, and five sizes of preheating tips, Nos. 4 to 8 inclusive, are available for the welder. Interchangeable welding-rod holders are furnished for $\frac{1}{4}$-, $\frac{5}{16}$-, and $\frac{3}{8}$-in. welding rod. Oxweld No. 24 "Lindeweld" process welding rod for use with the blowpipe is available in $\frac{1}{4}$-, $\frac{5}{16}$-, and $\frac{3}{8}$-in. sizes to fit the corresponding rod holders.

■

Struthers Dunn Electric Magnetic Counters

"Dunco" electric magnetic counters have been announced by Struthers Dunn, Inc., 139 North Juniper St., Philadelphia, Pa. The units may be used with photoelectric cells or for remote recording of production, vending machines, and remote counting of revolutions. Two types are available—

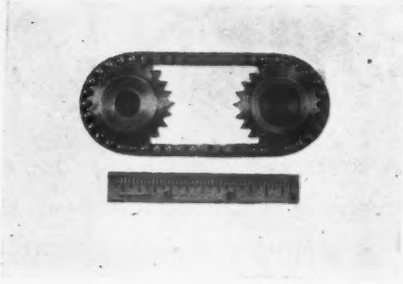


Type EC-1 is non-resetting and Type EC-2 is resetting. Both indicate numbers of five figures. The counter is added to the frame and mechanically connected to the armature of the unit so that each impulse of the coil trips the counter. The design is such that the base can be eliminated and the unit mounted on a frame for group installation. Type EC-1 will operate at speeds up to 75 impulses per min.; whereas Type EC-2 can be actuated to a speed of 350 impulses per min. Each unit is mounted on a base 3 in. wide and $4\frac{1}{4}$ in. long. Overall depth is $3\frac{1}{2}$ in. Counters are designed for continuous service and are available for any conditions of voltage and current.

■

Link-Belt Silent Chain Drive

Link-Belt Company, Indianapolis, Ind., announces the development of a $\frac{3}{8}$-in. pitch, silent chain drive designed to furnish a positive, flexible drive for



fractional horsepower motors and units. The chain is made in three types—middle-guide, side-flanged, and duplex. The middle-guide and side-flanged chains are employed where all shafts are driven in one direction, and the duplex chain is used where reverse direction is desired on some shafts, or where adjustment features are desired. The drive is being used as a transmission medium on such equipment as regulators, meters, and oil burners.

■

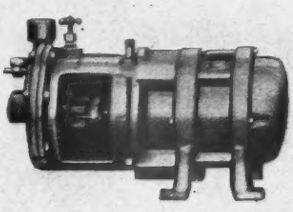
General Electric Circuit Breakers

Single-pole, solenoid-operated air circuit breakers, designated Type MC-5, for 650-volt, d.c., 1,200- to 10,000-amp. service have been announced by the General Electric Company, Schenectady, N. Y. Although built for general use, the instruments are adapted especially for use in steel mills and automatic substations where service conditions are severe and operation is continuous. The breakers are trip-free and consist of silver-to-silver, self-aligning main contacts; secondary arcing contacts; an arc chute provided with magnetic blowout; an over-current trip; and a direct-acting under-voltage or shunt trip.

■

Ingersoll-Rand "Cameron" Motorpumps

Ingersoll-Rand Company, 11 Broadway, New York, N. Y., announces that a number of sizes have been added to the "Cameron" line of small general service centrifugal Motorpumps to include 1-in. discharge and upward. Each unit is constructed so that the pump

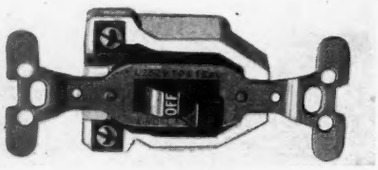


and motor are assembled as a single unit with a common shaft. No baseplate is needed for its installation. The discharge nozzle may be turned to any one of four positions. Only two bearings and one stuffing box are used. Bearings are of the ball type and require lubrication but once a year. The impeller is made of bronze and is hydraulically balanced. Renewable bronze wearing rings and a shaft sleeve are provided. The units are used against moderate heads in circulation systems, air conditioning equipment, stand-pipe and water-supply systems for factories, and condensate return systems. The pumps may be obtained in various motor combinations for all ordinary current conditions and for use in hazardous locations.

■

Cutler-Hammer Toggle Flush Switch

Catalog No. 7200, single-pole toggle flush switch has been announced by Cutler-Hammer, Inc., 253 North 12th St., Milwaukee, Wis. Both terminals are at one end of the switch for convenience in wiring. Switching mechan-



ism is of the "jumper" type with phosphor-bronze, non-stubbing contacts, a compression-type spring for quick make and break, a positive-acting "kick-off" feature to eliminate burning and pitting of contacts, and an arc horn on the movable contact which confines the arc to the extreme tip of the contact. Stationary contacts and terminals are of one-piece phosphor bronze. The switch has a porcelain body, removable plaster lugs, and a black or brown operating lever.

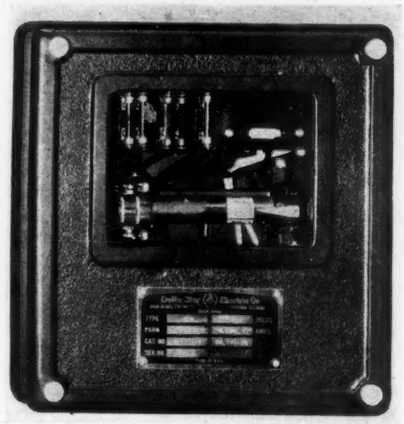
■

Lincoln "Fleetweld"

Introduction of a heavily coated electrode for welding within the shielded arc on mild steel has been announced by The Lincoln Electric Company, 12818 Coit Rd., Cleveland, Ohio. The electrode is known commercially as "Fleetweld." Its use is said to insure a high ductility of weld metal. The electrodes require high welding current and permit rapid welding speeds. They are available in diameters from $\frac{1}{8}$ to $\frac{3}{8}$ in., and in the standard 14-in., and the special 18-in. lengths.

Delta-Star Timer

Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill., announces a timer for use in connection with oil circuit-breaker auto-

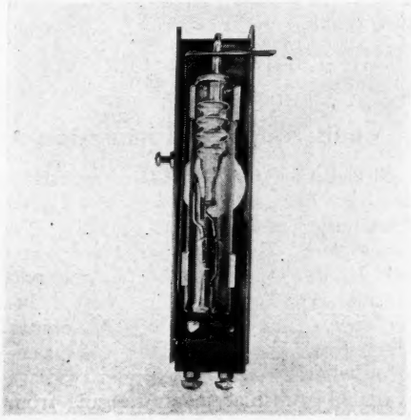


matic reclosers. The essential elements are a patented arrangement of a small transformer, two vacuum tubes, a condenser, a set of limiting resistors, relay contacts, and a solenoid ratchet-operated cam switch. The time element is determined by the rate of condenser charge and is governed by resistance steps. By introducing different resistances, any number of reclosures up to twelve at any desired time interval can be secured with final lockout.

■

Burgess Vacuum Contact Mounting

To facilitate the application of the Burgess vacuum contact to relays and other actuating mechanisms a mounting unit has been developed by the Burgess Battery Company, 295 Madison Ave., New York, N. Y. The mounting device consists of a C-shaped metal casing to protect the glass vacuum contact which is held in place by a pair of clips; a connecting link for coupling the actuating mechanism to the extension stem of the vacuum contact; and a pair of screw binding posts. When

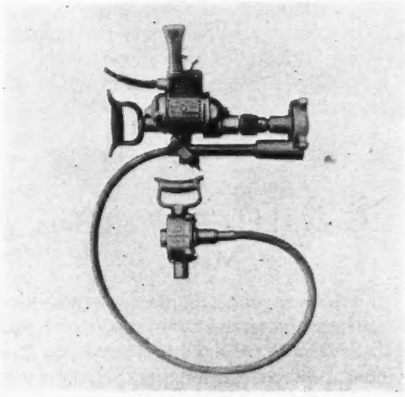


operating as an open circuit device, counter pressure is applied to the connecting link to offset the inherent spring tension that normally keeps the vacuum contact closed by means of an adjustment screw provided with a lock nut. By rotating the vacuum contact one-half turn in its string clips and adjusting the connecting link the vacuum contact may be operated as a closed circuit device. The mounting is applicable especially to the standard telephone relay. It also may be applied to any mechanical, manual, or themostatic form of actuation.

■

U. S. Electrical Tool Electric Hammer

An electric hammer weighing but 9 lb. has been announced by The United States Electrical Tool Company, 2475 West 6th St., Cincinnati, Ohio. The hammer is operated through a flexible shaft attachment which connects it to a ½-in. electric drill. This arrangement

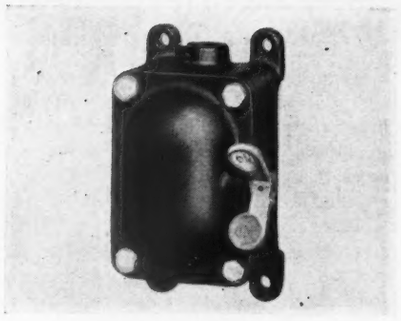


is claimed to prolong the life of the tool because no shocks are absorbed by the power unit when the hammer is in operation. Specifications state that the hammer will deliver 4,000 blows per min. with a 1-in. stroke or lower and that ball and roller bearings are used throughout.

■

Square D Explosion-Proof Control Station

Class 9001, Type BR-11 explosion-proof control station has been announced by the Industrial Controller Division of the Square D Company, Milwaukee, Wis. It has been approved by the Underwriters Laboratory for Class 1, Group D hazardous locations. The station is of the three-wire, momentary-contact type and is provided with one normally open and one normally closed contact inclosed in a cast-iron



housing. It is constructed so that it will withstand an internal explosion without injury to the inclosure and without transmitting flames to the surrounding gases. Approximate dimensions are 6½ in. high over the mounting lugs, 3½ in. wide, and 3¼ in. deep.

■

Electric Controller Explosion-Proof Starters

Type ZEO No. 1, across-the-line, explosion-proof motor starters have been announced by The Electric Controller & Manufacturing Company, 2700 East 79th St., Cleveland, Ohio. The instruments have been approved by the Underwriters for Class 1, Group D hazardous locations. Inclosing cases are strong and tight enough to prevent the transmission of any flame from within the cases to the surrounding atmosphere, and the flanged joints between the upper and lower parts of the cases are of sufficient length to cool any gases formed within before they can come into outside contact. The contactor mechanism and overload relays are mounted on a

removable slate base. Main contacts and overload relay contacts are oil immersed. The starters may be controlled by explosion-proof pushbuttons. Terminals are located above the level of the oil so that the oil will not cause deterioration of the insulation on the wires. The maximum ratings of the units are 5 hp. at 110 volts and 10 hp. at 220, 440, and 550 volts.

Motor and Plane Accessories Automatic Oiling System

An automatic electrically operated oiling system for use with industrial machinery and automobile chassis has been developed by the Motor and Plane Accessories, Inc., Detroit, Mich. It is provided with an oil tank equipped with a heater unit that is separated from direct contact with the oil. When the machine to be lubricated is started, the heater unit inside the tank is turned on automatically. The heat raises the temperature of the oil, and the resulting expansion forces oil out of the tank to the bearings where suitable metering devices control the flow of oil. After the temperature has reached 150 deg. F., a thermostat breaks the circuit and the oil is allowed to cool to 100 deg. F., at which temperature the thermostatic switch again makes contact. During the cooling process a vacuum occurs which is utilized to refill the tank from a central supply or reservoir. To prevent the vacuum from drawing the oil

back into the tank from the bearings a check valve is installed in the main feed line, and an auxiliary feeder is provided to maintain the pressure on the main line while the tank is refilling. The system operates every two hours. The illustration shows the tank with its cover removed to show the heating element.

■

Weston "Illuminometer"

Illumination intensities can be read with the same ease and facility as is experienced when reading ammeters and voltmeters by means of an instrument developed by the Weston Electrical Instrument Corporation, Newark, N. J. It is known as the Model 603 "Illuminometer."

The unit consists of an indicating instrument calibrated in foot-candles and a light target, assembled in a portable case. The light target is attached to the end of a flexible cord so that it may be placed in any position. The target or searching unit is provided with two Photronic cell units which convert light energy directly into electrical energy without the use of batteries or other auxiliary power supply. When the cell is in darkness no current is

generated. There are three ranges which indicate up to 10, 50, and 250 foot-candles respectively. A range-changing switch is provided for the selection of the desired scale. The absorption of light by painted walls, screens, and draperies can be measured directly by turning the light target so that it faces the desired surface.

■

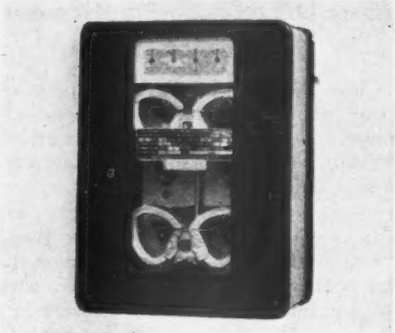
Victor Heavy-Duty Hack Saws

Victor Saw Works, Inc., Middletown, N. Y., announces the development of a line of heavy-duty hand and power hack saws. The blades are made of molybdenum steel and are available in all commercial sizes.

■

General Electric Watt-Hour Meters

Two types of polyphase, switchboard watt-hour meters, known as DS-21 and DS-23, have been announced by the General Electric Company, Schenectady, N. Y. Featuring the instruments is a switch-and-link arrangement by which the current coils first can be shunted and then completely isolated from the line. At the latter point direct connections can be made to the current coils for test. This feature provides a positive means of short circuiting the current transformer secondaries on transformer rated meters and prevents interruptions of service during tests on self-contained meters. Two ratings of self-



contained meters are available—5- and 10-amp. For current values above these ratings transformer-rated meters must be used. Type DS-21 is a two-element meter designed for use on three-wire, two- and three-phase circuits and four-wire, two-phase circuits. Type DS-23 meter is a three-element instrument for use on four-wire, three-phase circuits.

■

Roller-Smith Circuit Tester

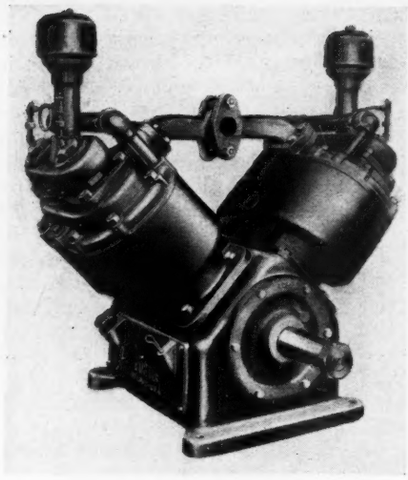
Type HTD-2 circuit tester has been announced by the Roller-Smith Company, 233 Broadway, New York, N. Y. Two scales are provided to permit close resistance readings within a wide range. One scale reads up to 5,000 ohms, and the other up to 50,000 ohms. The instrument mechanism is a flush Type TD model mounted in a molded bakelite case. It is equipped with a leather strap handle. Cushion-type feet on the back protect the instrument from jars. A toggle switch is provided to change the instrument from the low to the high

range. To adjust battery voltage a special rheostat is installed that can be manipulated by a screwdriver applied to the top end of the instrument. The instrument is equipped with a standard flashlight cell. When it is necessary to install a new battery the bakelite backplate is removed, and the new battery can be slipped into place. Overall dimensions are 6¼ in. high, 3½ in. wide, and 2½ in. deep. Weight, including leads, is 2 lb. A pair of flexible test leads fitted with rubber handles and pointed prods is supplied with each instrument.

■

Curtis Model C Compressors

Model C compressors for industrial use have been announced by the Curtis Pneumatic Machinery Company, St. Louis, Mo. The line consists of seven models, five of which are of the two cylinder type and two of the four cylinder type. The two cylinder machines range from 25 to 125 cu.ft. in displacement, whereas the four cylinder type are available in displacements ranging from



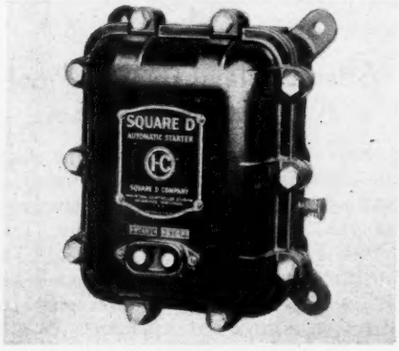
115 to 262 cu.ft. Units are furnished not only as simple stationary compressors for belt drive, but also as self contained units either direct connected or for multiple V-belt drive. They may be supplied with support wings instead of the regular base mountings for incorporation in portable units. Design and construction features include Timken roller bearings on the crank shaft; "Centro-ring" lubrication; and heat-treated, rust-resisting valves.

■

Square D Explosion-Proof Starters

Class 8532, Types AR-1 and BR-1 explosion-proof starters have been announced by the Industrial Controller Division of the Square D Company, Milwaukee, Wis. They have been approved by the Underwriters Laboratory for use in Class 1, Group D locations which include such hazardous atmospheres as are encountered in oil refineries and lacquer plants.

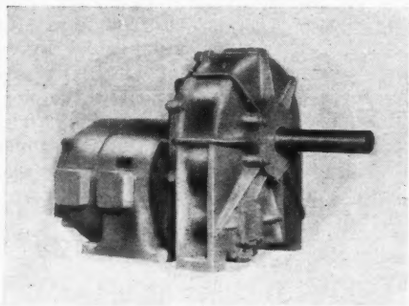
Type AR-1 has a "start-stop" push-button in its cover; whereas Type BR-1 is designed for remote control. The starter mechanism consists of a three-pole magnetic contactor and thermal overload relays mounted on a porcelain base. An explosion-proof, cast-iron inclosure surrounds the starter mechanism. The units provide low voltage protection and release as well as time limit overload protection to a.c. single-phase and polyphase, across-the-line motors. Maximum ratings are 1½ hp. at 110 volts; 3 hp. at 220 volts single phase; 5 hp. at 220 volts; and 7½ hp. at 440-550 volts polyphase.



■

Sterling "Slo-Speed" Motors

Sterling Electric Motors, Inc., 5401 Telegraph Road, Los Angeles, Calif., announces a line of electric motors designed for direct connection to slow speed machines. The motors have been termed "Slo-Speed." The speed of each motor is reduced to the required value by means of totally inclosed helical and herringbone gears built into the motor frame to form an integral unit. Gears are of the stub-tooth type, are made of chrome-nickel alloy and high-carbon steel, and run in an oil bath. Double oil seals are provided on incoming-rotor and outgoing-power shafts. Ball and roller bearings are used throughout. The units are available in motor types, speeds, and ratings to suit practically every industrial requirement.



■

Cleveland Worm Gear Reduction Units

Size 70 worm gear reduction units have been announced by the Cleveland Worm & Gear Company, 3258 East 80th St., Cleveland, Ohio. The units are designed to transmit up to 7½ hp., their capacity depending on the reduction ratio and worm speed. They are furnished in both horizontal and vertical types. Horizontal units are built with the worm either below or above the gear and are known as types AT and RT respectively. In the type VT vertical the gear shaft extends upward, whereas the gear shaft of the type VD extends downward. Type AT is shown in the illustration. In all types the worm and its shaft are made from a single nickel-alloy steel forging that is carburized, heat-treated, hardened, and ground. The worm gear is hobbed from a solid chill-cast, nickel-bronze blank. Oil seals are fitted on each shaft extension. The units can be obtained in a range of nine standard ratios that vary from 4 5/6:1 to 60:1. Fifteen special ratios also are available.

■

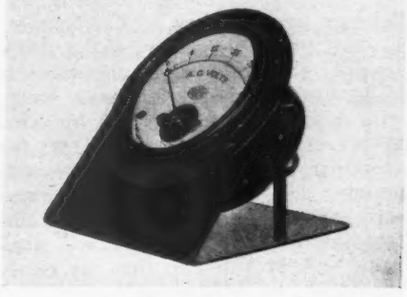
Crowley "Crolite"

Development of a ceramic, known as "Crolite" No. 7, that is reported to possess a coefficient of thermal expansion lower than that of any other known material has been announced by Henry L. Crowley & Company, West Orange, N. J. The material is adapted especially for use in the construction of precision instruments, spark-plug cores, and other products that require a minimum change in size with fluctuations in temperature and a high resistance to heat shock.

■

Roller-Smith Mounting Base

Roller-Smith Company, 233 Broadway, New York, N. Y., announces a mounting base, known as Type T, that is arranged so that it is possible to mount on it any metal or bakelite case, flush model Type TA, TD, or TW instrument. This combination results in a portable instrument for use in laboratories and manufacturing plants. The instrument is attached to the base by two screws. The size of the base alone is 3½ in. wide, 2 in. high, and 3⅜ in. deep. It weights 3½ oz. and is finished in black.



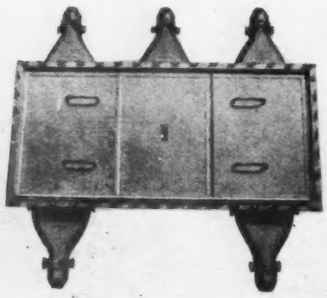
Fuerst-Friedman Company Changes Name to Electric Generator and Motor Company

Announcement is made by the Fuerst-Friedman Company, 1292 East 53d St., Cleveland, Ohio, that it has changed its name to the Electric Generator and Motor Company. Ownership, personnel, and location will remain unchanged.

■

Delta-Star Underground Cable Box

. Three loads from two sources can be handled by the underground cable box announced by the Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill. Load outlets are shown at the top and source inlets at the bottom of



the illustration. The box can be sectionalized so that the center load is carried on either of the two sources.

■

Pyrometer Division of Wilson-Maeulen Company Merges with the Foxboro Company

Announcement has been made that the Pyrometer Division of the Wilson-Maeulen Company, New York, N. Y., has merged with The Foxboro Company, Foxboro, Mass. Wilson-Maeulen pyrometers and controllers will be built at the Foxboro plant.

■

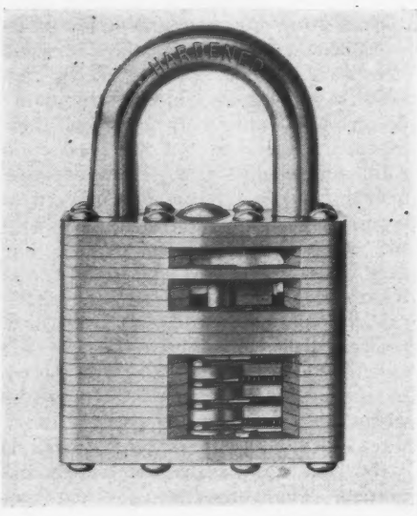
Pyrene Fire Extinguisher

Pyrene Manufacturing Company, 560 Belmont Ave., Newark, N. J., announces a 1-gal., pressure-type fire extinguisher designed so that its operating valve is in back when the extinguisher hangs on a wall. This feature was provided to prevent accidental opening of the operating valve and to discourage tampering. The liquid gage and air pressure gage are located in front to facilitate inspection. A hanger and hook have been provided so that the extinguisher can be hung on a wall or post. The operating valve functions fully at a half turn of the hand wheel. The air chamber is designed to discharge 1 gal. of liquid under pressure of 100 lb. per sq.in. Discharge time is 55 sec. with an effective range of 30 to 40 ft. As the extinguishing liquid is a non-conductor of electricity the extinguisher is safe for use with electrical fires. In operation the unit may be slung over the operator's shoulder by means of a carrying strap so that both of his hands can be used to direct the stream.

■

Master Lock "Secret Service" Padlock

"Secret Service" is the name of a pin-tumbler, brass-cylinder padlock with a laminated steel case announced by the Master Lock Company, Milwaukee, Wis. Twenty-two steel plates are forged together with eight rivets under 150 tons pressure to form the case. A hardened, reinforced steel shackle is imbedded in the case and is engaged with a locking lever of brass. Access to the locking lever through the keyway is impossible because of a steel-jacketed pilfering protector. The pin tumblers, drivers, and keys are of nickel silver. The entire lock is rust-proofed with cadmium. For special requirements of industrial users the lock is obtainable with a 10-in. chain, one end of which can be attached to the shackle with a special brass collar and the other end provided with an attachment plate. Units are obtainable in types that are keyed alike, master keyed, or grand master keyed.

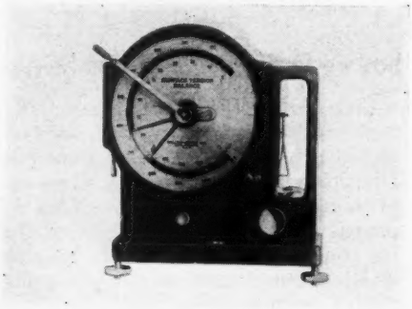


The padlock recently won the gold medal awarded by the American Association of Master Locksmiths.

■

Roller-Smith Surface Tension Balance

Roller-Smith Company, 233 Broadway, New York, N.Y., announces the catalog No. 2439 surface tension balance designed especially for measuring the surface tension of liquids. It has two scales, one reading in milligrams and the other in dynes per centimeter. The instrument is essentially a 1,000-mg. balance with a parallel scale

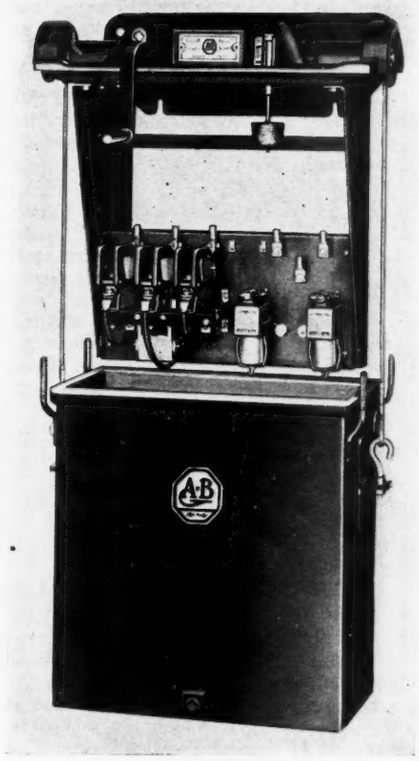


calibrated in dynes per centimeter. It is available equipped with the necessary platinum ring, watch glasses, and check weights. The instrument has a glass cover which shields the hook, ring, liquid, and stage. A stage is provided for carrying the sample in a watch glass. The stage is raised and lowered by a rack and pinion operated by a knurled knob located at the front of the case.

■

Allen-Bradley Explosion-Proof A. C. Starting Switches

Explosion-proof, across-the-line starting switches, of both the oil-immersed and air-break type, have been developed by the Allen-Bradley Company, 1311 South First St., Milwaukee, Wis. The switches are used with squirrel-cage and slip-ring motors on three-phase or two-phase three-wire systems, as well



as self-starting single-phase motors, in oil refineries, chemical plants, mines, and wherever inflammable gases or vapors are likely to be present. The maximum ratings are 25 hp. at 110 volts, 50 hp. at 220 volts, and 100 hp. at 440-550 volts. When used with slip-ring motors the switches are for primary control only.

Oil immersed switches are available with ratings of 50, 100, and 150 amp. The oil tank maintains at least a 6-in. head of oil above the switch panel. In the 100- and 150-amp. switches the tank is raised and lowered from a cast-iron head by two cable sheaves operated by a handle, thus allowing one-man inspection. The tank of the 50-amp. switch is so light that sheaves are not provided. The heads are arranged for wall mounting and are equipped with oil-level indicators.

The air-break type of switch is available only in the 50-amp. size. It is inclosed in a cast-iron cabinet with a hinged cover that is machined to obtain a tight fit without gaskets.

All switches have two magnetic overload relays. Contactors are equipped with copper-to-copper, rolling-type contacts as well as magnetic blowouts and arc shields.

■

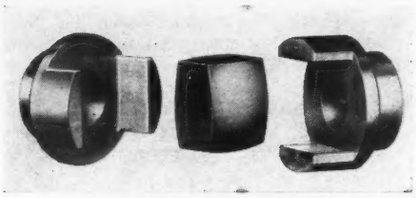
Lubriplate Lubricant

Lubriplate is the name of a line of oils and greases announced by the Lubriplate Corporation, 405 Lexington Ave., New York, N. Y. Characteristics claimed for the lubricant are that it smooths the bearing surfaces by plating them with a minutely thin film of zinc under pressure and that it possesses high viscosity and surface tension.

■

American Flexible Couplings

Two sizes, known as Nos. 4 and 6 with maximum bores of $\frac{3}{4}$ and 1 in. respectively, have been added to the line of flexible couplings manufactured by the American Flexible Coupling Company, Erie, Pa. The couplings are of the same general design as the remainder of the line. In operation a non-metallic, self-lubricating center part floats between the jaws of two flange sections. Power capacity is 0.05 hp. per 100 r.p.m. for No. 4, and 0.15 hp. per 100 r.p.m. for No. 6. Both sizes permit a maximum parallel misalignment of $\frac{1}{64}$ in. and a maximum angular misalignment of 1 deg. Although standard flanges are provided with one

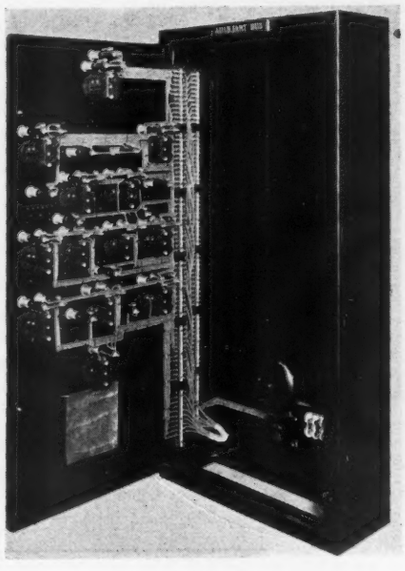


setscrew additional screws or keyways can be provided. Driving and driven shafts can be disconnected without dismantling the coupling.

■

Delta-Star Control Cubicle

To control station auxiliaries the Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill., has developed an arrangement of control



cubicle designed to save long cable runs. On the front of the hinged door is a diagram of the ring system used. The buses are represented by copper, and the cable by nickel strips. The door also carries twelve control switches and red, green, and amber position lamps. The cubicle is designed for location in the switchboard room.

■

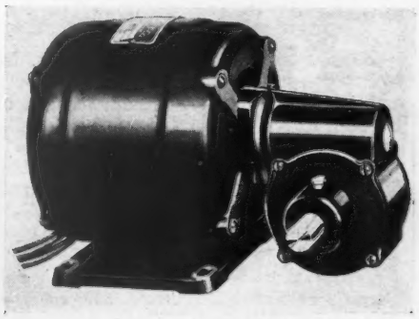
Columbia Plating Tank Rheostats

Columbia Electric Manufacturing Company, 1292 East 53rd St., Cleveland, Ohio, announces that its plating tank rheostats for medium and heavy currents up to 10,000-amp. capacity have been redesigned. Although the resistor-unit construction has been retained the design of the toggle-operated contactors has been changed so as to eliminate entirely the necessity for passing current through the contactor pin or other working parts. The former single-contact flexible brushes have been replaced by double-end contact brushes which are forced against the copper blocks by the toggle cams.

■

Bodine Motors with Built-In Speed Reducers

Fractional-horsepower motors with worm-gear speed reducers have been developed by the Bodine Electric Company, 2264 West Ohio St., Chicago, Ill. The motors are built into the Type N-5



frame. Gear reduction ratios of 10 to 1, 20 to 1, and 40 to 1 are available with standard motor speeds of 1,125 and 1,725 r.p.m. The speed reducer consists of a separable, alloy-steel worm and an oversize, bakelite gear, mounted in a grease-tight housing and forming an integral part of the end shield of the motor. Double-row ball bearings absorb the end thrust on the rotor shaft. The slow-speed shaft runs in leaded-bronze bearings with wool-packed lubrication. Motors are rated from 1/20 to $\frac{1}{8}$ hp., and are available in both a.c. and d.c. types.

TRADE LITERATURE

For copies, address the manufacturers concerned

■

(1) SWITCHGEAR—Reprint from "General Electric Review," "Automatic Switchgear and Associated Supervisory Systems for Industrial Service."—General Electric Company, Schenectady, N. Y.

(2) SIGNAL SYSTEMS—Bulletin 1016, 10 pages, the Strowger private fire alarm system.—Automatic Electric, Inc., 1033 W. Van Buren St., Chicago, Ill.

(3) PIPE LINES—Folder, 4 pages, Badger self-equalizing expansion joint.—E. B. Badger & Sons Company, 75 Pitts St., Boston, Mass.

(4) SWITCHES — Leaflet GEA-841B, CR7006-D40 magnetic starting switch for induction motors.—General Electric Company, Schenectady, N. Y.

(5) MOTORS—Bulletin 167, 30 pages, "Small Motors." The bulletin is divided into eight parts describing single-phase, polyphase, and d.c. motors in fractional-horsepower ratings. — Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo.

(6) INSTRUMENTS—Bulletin 160, 12 pages, type GSA a.c. portable instruments.—Roller-Smith Company, 233 Broadway, New York, N. Y.

(7) PUMPS—Bulletin 217, 8 pages, class LS single stage, centrifugal pumps.—Pennsylvania Pump & Compressor Company, Easton, Pa.

(8) SAFETY—"Safe Practices Pamphlet No. 66," pressure vessels—air receivers and hot water tanks.—The National Safety Council, 20 N. Wacker Drive, Chicago, Ill.

(9) PUMPS—Bulletin 216, 16 pages, class OMS and OMSB multi-stage centrifugal pumps.—Pennsylvania Pump & Compressor Company, Easton, Pa.

(10) WELDING—Catalog 57, 40 pages, "Rego" welding and cutting equipment.—The Bastian-Blessing Company, 240 E. Ontario St., Chicago, Ill.

(11) MOTORS—Bulletin 208, 4 pages, slow speed torque motors or rotating magnets.—The Ohio Electric Manufacturing Company, 5900 Maurice Ave., Cleveland, Ohio.

(12) VALVES—Booklet, 16 pages, a description of the "Lubrotite" gate valve with its uses.—Reading-Pratt & Cady Company, Inc., Bridgeport, Conn.

(13) PRECISION TOOLS—Handbook, 216 pages, data on gages, small tools, fixtures, special machines, and machine shop practice.—The Taft-Peirce Manufacturing Company, Woonsocket, R. I.

(14) PUMPS—Catalog B3, 12 pages, balanced single suction series pumps.—De Laval Steam Turbine Company, Trenton, N. J.

(15) POWER TRANSMISSION—Revised pages for the "New Departure Application Book," additions and revisions to listings of types, capacities, dimensions and mounting details of these bearings.—The New Departure Manufacturing Company, Bristol, Conn.

(16) GEARS—Folder GEA-1242A, 4 pages, Textolite gears and gear blanks.—General Electric Company, Schenectady, N. Y.

(17) MOTORS—Folder, 4 pages, two and three phase slipring and induction polyphase motors.—Century Electric Company, 1806 Pine St., St. Louis, Mo.

(18) CIRCUIT BREAKERS—Folder GEA-1442, dead front air circuit breakers.—General Electric Company, Schenectady, N. Y.

(19) LUBRICATION—Booklet, 16 pages, "Lunkenheimer Oil Cups and Oiling Devices."—The Lunkenheimer Company, Cincinnati, Ohio.

(20) ELEVATORS—Folder, 4 pages, architect's specifications of a standard size freight elevator.—The Warner Elevator Manufacturing Company, Cincinnati, Ohio.

(21) TANKS—Regulations of the National Board of Fire Underwriters for the construction and installation of gravity and pressure tanks, towers, and other equipment of this kind.—National Board of Fire Underwriters, 85 John St., New York, N. Y.

(22) CONTROL—Folder, 4 pages, electrically controlled pumps and pumping systems.—The Electric Controller & Manufacturing Company, 2696 E. 79th Street, Cleveland, Ohio.

(23) POWER TRANSMISSION — Folder GEA-1236A, 4 pages, Fabroil gears and gear blanks.—General Electric Company, Schenectady, N. Y.

(24) SWITCHES—New pages for Catalog 15: page 29-B, four-pole "Kappa" switch; page 48-A, "M-25" magnetic motor starting switches; page 50-A, magnetic motor starting switches for remote control; page 61-A, heater units for "M-25" magnetic motor starting switches.—The Trumbull Electric Manufacturing Company, Plainville, Conn.

(25) PIPING—Booklet, "Piping Tailored to Fit," a reprint of a paper presented before the Boston meeting of the American Welding Society.—Air Reduction Sales Company, Lincoln Building, E. 42nd St., New York, N. Y.

(26) EXPANDED METAL—Booklet ML-24, 16 pages, "Industrial Uses for Red Top Expanded Metal."—United States Gypsum Company, 300 W. Adams St., Chicago, Ill.

(27) MOTORS—Data book, section 210, 20 pages, geared head motors for speed acceleration or reduction.—The Master Electric Company, Dayton, Ohio.

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(29) RELAYS—Folder GEA-1314A, 4 pages, induction time relays for a.c. circuits.—General Electric Company, Schenectady, N. Y.

(30) MOTORS — Folder, Sterling slow speed motors.—Sterling Electric Motors, Inc., 5401 Telegraph Road, Los Angeles, Calif.

(31) METAL COATING—Folder, 4 pages, the metallizer, a device for applying metal finishes by means of atomization.—Metallizing Company of Los Angeles, Limited, 1218 Long Beach Ave., Los Angeles, Calif.

(32) FURNACES—Bulletin 220, 4 pages, "Falcon" straight line continuous electric furnaces for hardening and tempering strip steel.—H. O. Swoboda, Inc., 3400 Forbes St., Pittsburgh, Pa.

(33) ARC WELDING—Plate 30 of a series of studies in structural arc welding.—"Arc Welded Mill Buildings—Purlin Connections to An Existing Structure."—The Lincoln Electric Company, Cleveland, Ohio.

(34) STOP NUTS—Form 12, 4 pages, technical data on the use of elastic stop nuts.—The AGA Company, Elizabeth, N. J.

(35) EXPLOSIVES — Booklet, 34 pages, photographs and description of experiment station and research laboratories.—Hercules Powder Company, Wilmington, Del.

(36) ILLUMINATION—Circular A-1, 4 pages, Model 603 direct reading illuminometer, a light reading instrument.—Weston Electrical Instrument Company, Waverly Park, Newark, N. J.

COMING EVENTS

Second International Heating and Ventilating Exposition—In conjunction with the American Engineers and the American Society of Refrigerating Engineers, Cleveland, Ohio, January 25 to 29, 1932. The exposition is under the direction of the International Exposition Company, Grand Central Palace, 46th St. and Lexington Ave., New York, N. Y.

American Gear Manufacturers Association—16th Annual Meeting, Cleveland, Ohio, May, 1932. Secretary, T. W. Owen, 3608 Euclid Ave., Cleveland, Ohio.

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MAINTENANCE ENGINEERING

1931 EQUIPMENT NEWS

All of the items listed were described in the Equipment News Section during 1931. Reference symbols refer to issues and page numbers. The following abbreviations are used to indicate the months: Ja — January; F — February; Mr — March; A — April; My — May; Ju — June; Jy — July; Au—August; S—September; Oc—October; N—November; D—December

This index, filed with the twelve 1931 issues, will constitute a valuable equipment guide.

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Sanders: dustless, 1-hp., Jy371; portable, belt-type A215
Saws: attachment, for portable electric drill, Jy371; band, two- and three-wheel, Ja41; portable, universal motor Au417
Screw extractors Oc525
Soldering irons: cordless, Mr150; gas, ½-to 5-lb. Ju312
Tilters: carboy, safety clamp for, F103; carboy D622
Tube benders, hydraulic steel..Au415
Tubes, seamless lined steel....Mr150
Vise posts, portable S477
Vise stand, tool chest combination Au415
Vulcanizer, rubber belts up to 60 in. Ja39
Wheel cutter, ⅛- to 2-in. range..Ja49
Winding and banding machine, universal Mr151
Wire rope, performed A217
Wire threading terminals, for 0- to 6-gage Jy374
Woodworking machine, combination of all common tools....My264
Wrenches: alloy steel, ¾- to 1⅛-in., My262; detachable socket, ½-to 2⅜-in. Ja42
Wrench sets: 87 chromium-plated wrenches, ¼- to 1⅜-in. sizes, Ju313; extra heavy duty, Jy374; ¼- to 1½-in. socket range..D623

SUBSTATION EQUIPMENT

Bushings, high capacity, roof..Mr153
Bus clamps, roller type Oc520
Bus support, 25-kv., heavy duty Ja45
Cable junction box, aluminum-alloy D618
Circuit breakers: indoor oil, 600 and 1,200 amp., 15,000 volts, A215; triple pole, oil Oc522
Clamp and expansion washer..N575
Connectors, copper, busbar....Mr153
Cubicles, weatherproof, for automatic switchgear F100
Disconnects, fused, single pole, 300-amp., 15-kv. Ju315

Fuse, spring type N576
Mechanism, switch operating... S474
Mountings: outdoor fuse, single phase, high voltage, Ju317; fuse, 1-amp. Au422
Spreader head, cable, oil filled.. A217
Switches: gang operated, disconnecting, Ja41; disconnecting, 600-amp., 37-kv., single pole, Ja45; 7.5-kv., single pole, indoor type, disconnecting, Ja47; disconnecting, 4.5-kv., 300-amp., F98; gang operated disconnecting and air break, My260; disconnecting, porcelain housed, 400-amp., 7,500-volts, My263; fuse, open type, 7.5- and 15-kv., 30- and 60-amp., Ju311; disconnecting and fuse mounting, 15-kv., Ju314; disconnecting, 15-kv., 600-amp., Jy372; high voltage, gang operated, Au418; gang operated, 7.5- to 161-kv., S475; grounding, gang operated, Oc527; disconnecting, 7.5-kv., 200-amp., N576; single pole disconnecting, 7.3-kv. N577
Switchgears: 600-volt, metal inclosed, draw-out, Ja44; metal clad, unit type, Ja47; metal clad, Ju310; metal clad, 600-amp. 7.5-kv., Ju312; metal clad, 65,000-kva., 7,000-volts, Au417; metal clad, 7.5-kv. D621
Switch houses: outdoor, up to 15,000 volts, F102; outdoor..... Jy371
Switch units: gang operated, F99; single pole, remote control, 4.5- to 23-kva. D625
Terminators: cable, Mr148; multiple conductor Ju316
Transformers, air cooled insulating and auto D620

WELDING EQUIPMENT

Blowpipes: welding, Mr146; medium pressure Ju309
Cutting apparatus Au423
Electrodes: for arc-welding corrosion resisting steel, A126; welding, Au420 ..... S475
Manifolds, welding, twenty tank Mr146
Rod, welding Mr153
Torch, blow, 1-qt., seamless brass tank, Jy369; cutting, S474; welding, and cutting attachment, S475; cutting and welding..... S475
Welders: 600-amp., electric or gasoline drive, Ja39; portable, semi-automatic, open or shielded arc, Ja42; pipe line, 600-amp., engine driven, Ja43; hydrogen, automatic, longitudinal seam, Ja46; electric, portable, F100; portable, 200-amp. gasoline engine, F102; 8.5- to 125-amp., Au418; 100- to 600-amp. S474

WIRING AND DISTRIBUTION EQUIPMENT

Attachment cap, with hand grip N576
Attachments, electric, armored cord cap and connector S473
Bond, nut, spur type Ju311
Cables: underground, 600-volt, single conductor, My263; underground, non-metallic and metallic, Ju312; oval and oval tubing.. N577
Cable boxes, low voltage, underground A216
Cable rack My264
Circuit breakers, air, 4,000-amp. a.c. and 10,000-amp. d.c.....Au416
Clamps, fuse clip D625
Conduit, easy bending My263
Conduit fittings, vapor proof..Mr153
Contactors, a.c. and d.c.....Au416
Cutouts, fuse, porcelain housed expulsion type F97
Fuse reducer A214
Hangers for conduit and pipe up to 2½ in. My261
Insulation, colored rubber, for code wire Oc523
Insulator, feeder wire Oc524
Panelboards, interchangeable unit Ja46
Panels: safety, Au422; fuse, branch circuit Oc527
Plug cap, flush motor Ju313
Receptacles: with outlet box cover, Ju312; screw ring Au420
Sockets, porcelain, ½- and ⅜-in. sizes Ju310
Splice boxes, cable, two-, three,- and four-way A214
Supports, collector rail N571
Switchboard devices, plugs and receptacles Mr148
Switchboards, standardized sectional, totally inclosed Ju311
Switches: flush tumbler, 10-amp., 125- or 250-volt, My265; cord, tumbler type, Ju316; safety, Au416; heavy duty, safety, S475; front operated, safety, Oc524; service, range and meter, Oc527; mercury tumble N577
Twist-lock devices, three-wire..Oc520
Wire and cable, insulated aluminum Ja40